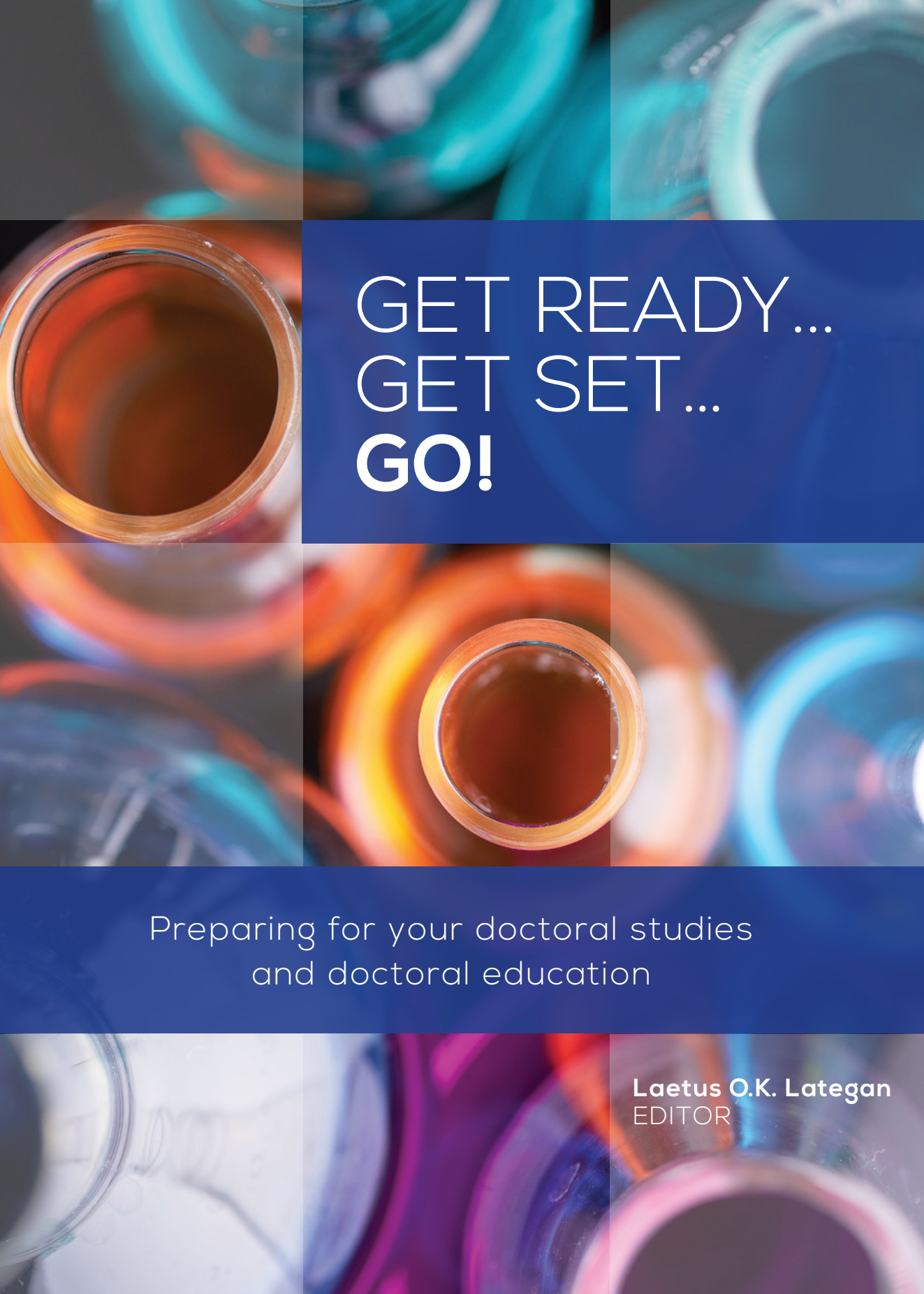

GET READY... GET SET... **GO!**

Preparing for your doctoral studies and doctoral education

Laetus O.K. Lategan
EDITOR

sb

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SUNBONANI SCHOLAR

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DEVELOP THE ART OF POSITIONING YOURSELF TO BE IN THE 'RIGHT PLACE AT THE RIGHT TIME.'

PETER HAWKINS

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CONTENTS

LIST OF TABLES AND FIGURES

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PREFACE

It is safe to say that all universities are positioning themselves to grow their postgraduate enrolment. This strategy is informed by national policy directives to become more research competitive, the demands by the knowledge society, the ranking position of a university, the link between postgraduate studies, research outputs, research culture and consequently research competitiveness. A reality is, however, that greater numbers of students will put considerable strain on human, financial and infrastructure resources. This will also challenge the way that postgraduate supervision is practised at universities. Apart from the well-known challenges around supervisors' and students' roles and responsibilities, methodological comprehension and writing skills, more attention should be given to creativity, innovation and entrepreneurship in the "postgraduate curriculum". Part of research education we should also focus on is scholarship, ethical practice, socio-economic development, responsible citizenship and nation building. The focus should essentially be on three competencies:

- To fit questions and arguments into the broader context of the scientific domain and its application to business and industry.
- To experiment by asking questions such as: can things be different? Is an alternative possible? What are the possibilities of this research?
- To foster creativity and to grow talent. Research depends very much on one's imagination and ingenuity.

From these comments, two needs can be highlighted:

- The need to train postgraduate supervisors
- Monitoring and evaluation of performance

This book presents different perspectives of support of the doctoral education value chain. The following prominent views are promoted:

- Postgraduate studies should be regarded as dedicated teaching that will lead to learning based on new knowledge generated. This demands a new look at matters such as formative assessment and the debate around the "hidden curriculum" in postgraduate studies and scholarship.
- Research projects should deliver on what can be referred to as useful or user-friendly knowledge – meaning that without the prospects of quadruple helix

partners benefiting from research results, we are not delivering on our national mandate (see for example the National Development Plan, and the White Paper on Post-school Education).

- Multi-, inter- and transdisciplinary research is no longer an option – it is a necessity. The days when we worked in silos [with a separation between Science, Technology, Engineering and Mathematics (STEM) and human and social sciences or "hard" and "soft" sciences] are long gone! A global economy demands a new look at for example health, energy, transport, food safety and security, communication, environment and sustainability.
- Research, innovation and entrepreneurship cannot be separated. The research value chain is incomplete if we have the traditional "research problem and solution" only, without taking the solution now to application, innovation or the way in which it can steer economic growth.

This book forms part of one of the three pillars of postgraduate research, namely research capacity building. The other two pillars are policy and methodology, which are addressed in other publications.

We trust that this book will support both doctoral supervisors and doctoral students in doing successful postgraduate research.

Laetus O.K. Lategan
Editor

Bloemfontein, April 2017

PROLOGUE

Setting the scene

Act 1, Scene 1 (Scriptwriter – Laetus O.K. Lategan)

Setting: New committee room of the Health Sciences and Human Therapy Faculty

Scene: Roundtable discussion of staff and students considering the new research policy, 2017-2020.

Characters' demeanour: Relaxed.

Opening scene: Someone is sending a text message. One professor is playing on an iPad. The deans are talking and laughing as they enter the room ...

Dean of the Faculty (makes an announcement): "The Faculty needs to grow its research outputs by 20% over the next few years".

Dean of Research (interrupting): "Especially female graduates are a challenge. And please remember that we are not talking numbers only but also the values of Vision 2020. And the requirements of the HEQF and ..."

(A few coughs ... all clearly thinking to themselves – what new document is he referring to? These deans – always talk, talk, talk. Blah blah blah ...)

HoD (responds): "I am also concerned that supervisors in my department have difficulty implementing the policy on the publication of a paper before a student can graduate".

Senior supervisor (frustrated and worried, but silent): "Now I have to interrupt my sabbatical plans to get the student to rework the study".

Senior lecturer (unhappy but not saying a word): "How will I ever get promotion – the expectations are just growing!!"

Postgraduate PhD student (nervous of speaking out but raises a hand): "Prof., my supervisor is on sick leave. I have not received feedback on the chapters I submitted three months ago. And now the Prof. over there says we must do more? When will I ever graduate? My funds are running out."

Act 14, Scene 1 (Scriptwriter – Hesta Friedrich-Nel)

Scene: One Saturday morning in the study of a doctoral student. The female student has a full-time job at a university.

She thinks: "At last I have a free morning and time to myself! Today I have the courage to e-mail my supervisor. I know I have ignored his e-mails lately because I haven't kept to the deadlines agreed to during our last session. I have an idea that my supervisor is irritated about the lack of progress but I don't have the confidence to explain my difficult situation and my challenges. I'm sure Prof. will be OK with an e-mail on a Saturday. At least the message will be in the inbox when he opens his e-mails on Monday ...".

Act 14, Scene 4 (Scriptwriter – Hesta Friedrich-Nel)

Scene: The same Saturday morning in the supervisor's office – a rated researcher and a professor at a prestigious research-intensive university. His services as a doctoral supervisor are much in demand.

He thinks: "I can't believe this! Yes, indeed! An e-mail from the 'missing' student – after she ignored my reminders and didn't stick to the agreed deadlines. I wonder what excuse she will come up with this time! I get the idea that she is avoiding me. I'll reply immediately and tell her that I'm not happy that she sends e-mails on a Saturday and claims MY research time after having been 'absent'. I am definitely not going to use MY time on HER research project today ...".

Act 14, Scene 5 (Scriptwriter – Hesta Friedrich-Nel)

Scene: In the study of the doctoral student 5 minutes later ...

She thinks: "It must be my lucky day – a reply from my busy supervisor! No wonder the students line up to work with him. This response might help me to find the courage to talk to him about my challenges and also make much needed progress with my project over the weekend".

Act 17, Scene 11 (Scriptwriter – Laetus O.K. Lategan)

Setting: "In a small office at one end of the Science Building, the professor is reading through his final notes in preparation for his speech to an annual doctoral education conference. His topic is: What are the core characteristics of a researcher? He has new glasses. His assistant has just informed him that the experiment did not produce

the expected results. Before he leaves the office to go and deliver his speech he looks around for his tie. The telephone rings ...

Professor (speaking softly, but not answering the phone): "I will call back."

Fifty minutes later he is invited by the chairperson to address the plenary session audience at the Conference.

Professor (*viva voce*): President of the Conference, distinguished guests, ladies and gentleman. I have been assigned to reflect on the art of being a researcher. I was reminded of what my mentor once said: the academy is a laboratory of new and applied ideas. It is *the* place where we need to ask questions. In typical Socratic fashion, the one question should follow the next. There is never an end to questions. Or to seeking new answers and solutions. In my opinion there are five questions to be asked:

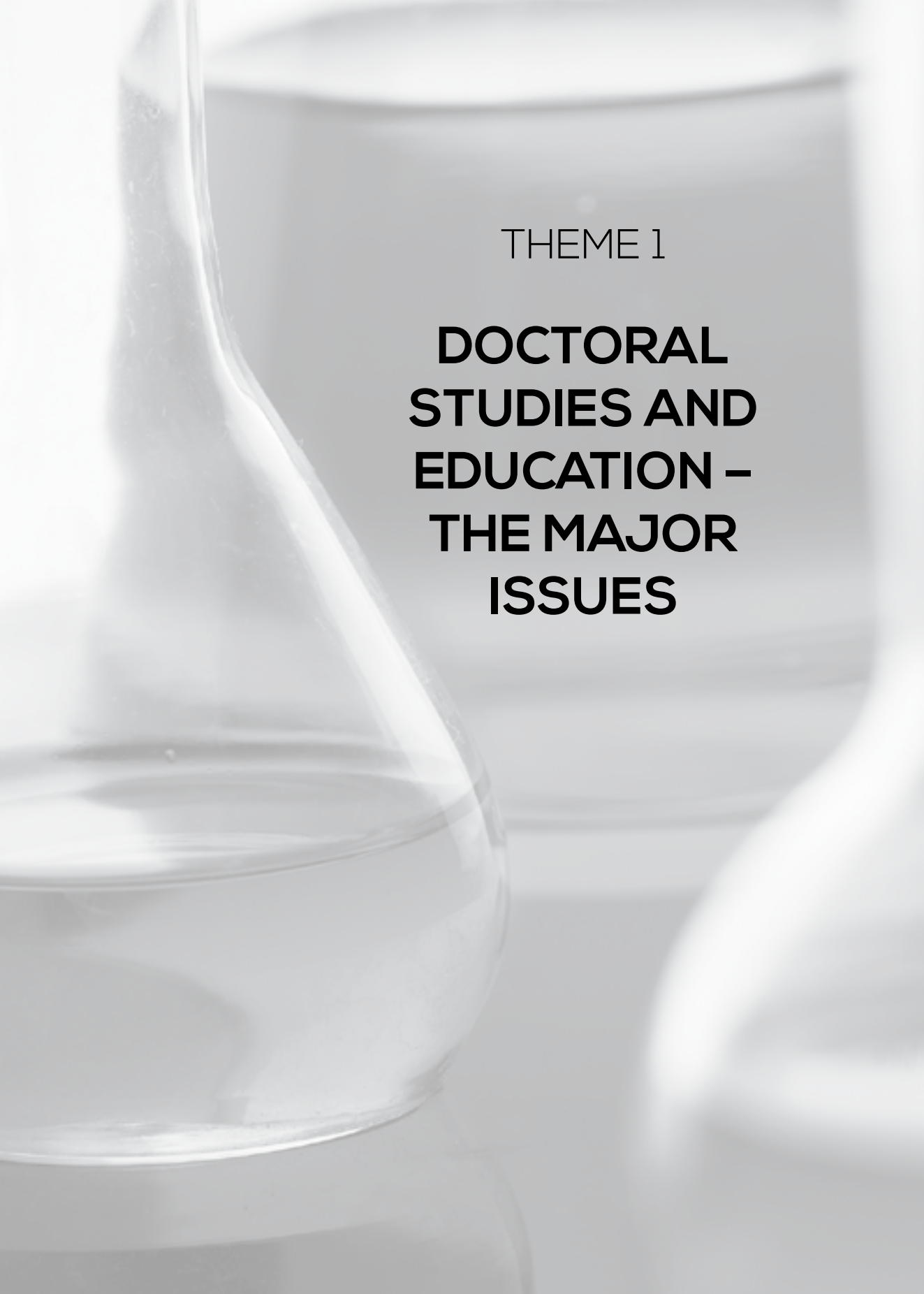
- Who are the five leaders in your field of research?
- Which are the five leading journals in your field of research?
- What are the five most important research questions in your research field?
- Can you name five active research collaborators that you may have?
- Is your research aligned with the major research questions in your field of research?

I strongly believe that ... (the cell phone rings)

Act 23, Scene 14 (Scriptwriter – Laetus O.K. Lategan)

Scene: Somewhere in a side corner of a laboratory at a university known for its work on biodiversity, sits an elderly professor busy typing an assessment report. This university laboratory is part of an international pharmaceutical company.

"... This study lacks conceptual analysis, the empirical evidence is suspicions, and the literature is limited to the South African experience. Let me substantiate my comments ..."



THEME 1

DOCTORAL STUDIES AND EDUCATION – THE MAJOR ISSUES

WHAT ARE THE MAJOR ISSUES?

LAETUS O.K. LATEGAN

1. Doctoral studies – of interest to many

Doctoral studies are of interest to many people.

For the government of a country, it should be a way to stimulate social, technological, industrial and economical dynamics, eradicate poverty, contribute towards the wealth of a nation and to grow healthy societies. For the economy, knowledge has become a "raw material" – i.e., it has commercial value. For universities, it is a way to grow the knowledge base, to become more research competitive and to meet the demands set by the knowledge society. At the same time, doctoral studies can improve the national and international ranking of a university, expand participation in research programmes, and be a direct contributor to research competitiveness. For society it is a means to grow the social fabric of communities.

Growing the number of doctoral students, however, requires much more than mere application of marketing strategies. There is wide-spread consensus that promoting doctoral studies requires a multi-faceted understanding of such studies. A recent example is the Academy of Science of South Africa's (ASSAf) report: "*The PhD Study: An evidence-based study on how to meet the demands for high level skills in an emerging economy*" (2010). This study outlines a number of challenges associated with doctoral studies. These challenges can be grouped into four categories: firstly, *the readiness and preparedness of students,* secondly, *the training of supervisors,* thirdly, *the relevance of studies for economic growth,* and lastly, *how doctoral education can assist in building a next generation of researchers.*

These challenges are further unpacked and informed by the SARUA (South African Regional University Association) Report on Doctoral Education (2012), the White Paper for Post-school Education and Training (Department of Higher Education and Training, 2013) and the National Development Plan (NDP): Vision 2030 (2011).

These studies and reports cannot be read in isolation from the Higher Education Qualifications Framework (2007), which states that doctoral students need to give evidence of their skills and competencies, independent research, scientific communication and their ability to supervise other students. The obvious conclusion is that doctoral studies entail much more than simply writing a thesis – in other words, it does not consist of research only. There are teaching and learning activities needed to support the research component of the study; writing and communication skills are required to present the research results to the scientific community; and furthermore the research results need to be applied, technology transferred and innovation ensured. Successful doctoral studies are obviously far broader than just the documentation of the research – in other words, the writing of a thesis.

Three important conclusions can be drawn from the above report, White Paper and NDP:

- More attention should be paid to the education, training, exposure and student experience of doctoral students.
- The training of doctoral supervisors should be a priority for the university.
- Doctoral studies require a deeper engagement between the role-players: the university as custodian of the academic project, the supervisor as academic expert, tutor and gatekeeper for academic quality, ethics and integrity, the student as next generation researcher, and society in general (collective for government, business, industry and social communities).

Following from these reports, it is evident that we need to pay closer attention to the research culture required to support doctoral studies and also to the challenges associated with this culture.

2. Let's get practical – dealing with realities and expectations

I have studied the doctoral research process and practice for many years.

One of the first things I investigated was how students view their supervisors. I posed this question to students as an ice-breaker during one of my workshops on postgraduate supervision. I asked the students to draw a picture of their supervisors. The instruction was clear – capture the relationship and not just the person. At the back of my mind was the knowledge that, from the fields of Art and Psychology, we learn that drawings can interpret the search for meaning and understanding. Art also expresses how people

perceive reality: how it is, can be or ought to be. I also thought that the drawings might assist to change "negative" behaviour to "positive" behaviour.

I was very pleased with the drawings that I received.

From these drawings, the following observations were made:

- The existence of a good relationship is essential for the supervisor-student relationship.
- Supervisors follow different supervision styles (order/chaos).
- Professional behaviour can never be compromised.
- Both supervisor and student need to be committed to the successful completion of a study.
- Supervisors should be mindful of students' anxiety, whatever the reason may be.
- Complexity of process.
- Supervisors should be role models for their students.
- The supervisory relationship should be professional at all times.

Another project I undertook was to look at the enrolment, retention and completion rates of students over a number of years. An analysis of doctoral programmes and studies suggested the following challenges (these challenges are generalised to outline what should be in place for all programmes and studies):

- Time duration to completion of studies is too long.
- A large percentage of doctoral students are studying on a part-time basis.
- Few doctoral students are applying for external bursaries.
- Too few publications are following from completed studies.
- Supervisors do not always know how to deal with formative assessment.
- Many doctoral students cannot manage a publication as a condition for graduation, the defence of the study (viva) or how to present the research results to a broader research community.

In a third project I considered the doctoral value chain. Following from this observation, I identified the following needs:

- Knowledge of the research design, appropriate method(s) and its/their methodologies.
- Know-how in relation to the literature review, analysis and reflection.
- Intersection of research, learning, application and scholarship.

- Appropriate ethical behaviour and integrity.
- Generation of new knowledge and understanding.

On the basis of these three projects, I can draw the following pointers for doctoral studies:

- Not all supervisors are sufficiently prepared to supervise students. What should be understood is that doctoral supervision is a science in own right. The following comment is well known: *The acquirement of a PhD does not provide enough expertise to supervise a student!* Supervisors should therefore continuously practise the art of postgraduate supervision in order to be successful. Theme 4 will look in greater detail into this matter.
- No clear role definition between the supervisor, supervisory panel, students and other support such as language editing (and not rewriting), and statistical assistance (doing the statistics without knowing how to do the statistical analysis). Doctoral studies (similar to other studies) should be regarded as *dedicated teaching* that will lead to learning based on new knowledge generated. This demands a new look at matters such as formative assessment, the debate around the "hidden curriculum" in postgraduate studies, and scholarship. Themes 3 and 4 will look in greater detail into these matters.
- Not all undergraduate programmes have (sufficient) research methodology modules, hence master's students often have difficulty in comprehending the scope of postgraduate studies; this in turn has an impact on doctoral studies. In addition, there are the research method and the research design (research objectives and problem statement), which are not always aligned. Knowing the appropriate research method and understanding the methodology are important for successful doctoral studies.
- Multi-, inter- and transdisciplinary research are no longer options – they are necessities. The days when we worked in silos [a separation between Science, Technology, Engineering & Mathematics (STEM) and human and social sciences or "hard" and "soft" sciences] are long gone! A global economy in a post-structural society demands a new look at, for example, health, energy, transport, food safety and security, communication, environment and sustainability. Theme 6 will look in greater detail into this matter.
- The purpose of the literature review is not always clear. Many students regard this as a summary of what is in the public domain instead of reflecting on the literature to identify where the gaps are in a particular discipline. The purpose of the literature review is not to repeat what has already been said but rather to engage with an existing line of thinking related to the research topic.

- Students have limited postgraduate exposure to research activities beyond writing the thesis. Students should be exposed to colloquiums, seminars, conferences, presentations, publication writing and opportunities to share newly gained knowledge.
- Research is not always relevant. The supervisor and student should continuously ask whether the research topic is relevant, and how relevant it is, to the needs of society. Research projects should deliver on what may be referred to as useful or user-friendly knowledge – meaning that without the prospect of government, business, industry or social communities benefiting from research results, we are not delivering on our national mandate of research and innovation [see for example the National Development Plan (NDP) and the White Paper on Post-school Education].
- Research, innovation and entrepreneurship cannot be separated. The research value chain is incomplete if we have the traditional "research problem and solution" only, without taking the solution onwards to application, innovation or the way in which it can steer economic growth.

These observations have led me to conclude that the doctoral student needs a range of skills and competencies to be successful in his/her research project.

Specific thinking skills and behaviours can be identified based on Deon Rossouw's *Intellectual tools: Skills for the human sciences* (2003):

- The willingness to listen to, investigate and understand new ideas (tolerance).
- Intellectual fairness – don't concern yourself with irrelevant hair-splitting or unnecessary criticism.
- Honesty concerning your own prejudice, preferences and sentiments.
- Willingness to analyse. Understand what the debate/topic is all about.
- The willingness to fit questions and arguments into the greater context.
- Willingness to experiment. Can things be different? Is an alternative possible?
- Intellectual perseverance. It takes time to work through an argument and to form your own perspective.

A basic conclusion from these observations is that students may have the knowledge to perform the research but do not necessarily have sufficient background to frame their research in the larger context of the research agenda in general and their discipline of study in particular. Following from this comment I want to argue that students should be able to contextualise their research projects in the larger domain of a global research agenda. This will secure responsive, relevant and user-friendly research and research results.

3. Relevant research means responsive, reflective and real-world research

Globally, universities have three defined missions: *Research* (generation of new knowledge), *teaching* (transfer of existing knowledge) and *engagement* (application of new and existing knowledge). Many universities have extended their research mission to include innovation, because innovation is based on the application of new knowledge in a creative and user-oriented manner. In addition, research and innovation both have multi-, inter- and transdisciplinary approaches to solving quadruple helix problems and challenges.

As research and innovation are closely associated with academic activities they should both contribute to scholarship. Such scholarship should be based on extending the academic discipline in theoretical scope (research) and in innovation (application and new knowledge generation).

Another concept that needs to be linked to research and innovation is *technology transfer*. Technology transfer and innovation are usually understood as those activities that extend the knowledge value chain to advance the application of knowledge and to present new and different possibilities in terms of application of knowledge. Technology transfer and innovation form the cornerstones of applied sciences and provide a springboard for Mode 2 knowledge development. From the National Science and Technology Plan (Department of Science and Technology, 2008-2018) five "grand challenges" can be identified around which innovation efforts can be focused:

- "Farmer to Pharma" value chain to strengthen the bio-economy
- Space science and technology
- Energy security
- Climate-change science
- Human and social dynamics, including issues related to service delivery

The focus of research and innovation activities should be on:

- increasing overall research outputs
- increasing research participation and capacity
- diversifying research funding
- offering specialised research programmes/courses
- improving employer engagement (in the workplace)

- establishing long-term mutually beneficial research partnerships with business and industry

The intersection between research and innovation is further informed by what I would like to call the "global" research agenda.

Based on a study of various research agendas (such as African, American, Asian, Australian, Canadian and European Union research agendas), the following *research themes* can be identified. *Note that these research themes should not be confused with government's research priorities*.

- Bio-agriculture
- Bio-diversity
- Bio-technology
- Climate change
- Destructed families
- Energy (green, renewable)
- Eradication of poverty
- Food and personal safety and security
- Growing aging population
- Health systems and treatment of (infectious) diseases
- New economic systems
- Sustainability
- Transport

The purpose of mentioning these themes is simply to state that relevant and real-world research is linked to a broader research agenda and scope and that one should accept that there is a global discourse on a particular matter. One's doctoral research cannot ignore the global discourse on any particular matter.

As important as the above-stated comment is, so is the observation that no research agenda can be removed from an ethics basis. Teaching research ethics and integrity to the doctoral student is no luxury but rather a necessity.

4. The values basis for research

In the research ethics value chain there are different activities to be considered. Four important activities are:

- principles, values, norms, virtues informing research
- basic guidelines on what constitutes good and respectful research
- national and international research ethics and integrity codes
- institutional regulations and compliance

Linked to research ethics is research integrity. Integrity can be seen broadly as the public's confidence in the research that we are doing.

Research ethics and integrity touch on the debate regarding what science is, what its foundations are and what kind of research we are engaging in. Disrespectful research, scientific misconduct, fraud, and any kind of irregularity cannot be ignored. We should ask questions related to relevance, application, replication, and so forth.

Research waste is a growing concern. Although the term is harsh, the issue is that we contribute to research waste when our research lacks basic research foundations, integrity and purpose. A typical example of research waste is when the wrong question is asked: the answer is either known or invalid, not applicable and/or irrelevant, or not adding to the scientific discourse. Weak study design also contributes to research waste. Another example of research waste is research results that are either not published, or selectively published or the research outcome is not useful. A neglected issue is that resources and time are wasted in performing the research project.

Sloppy science (see Singapore Statement on Research Integrity, 2010), publication bias, waste and misconduct (versus fraud) are often evident in research. A major concern is that research is not reputable enough, often invites speculation as to the intention and outcome of the research and it adds nothing new to the current knowledge basis. Recycling and little or lack of relevance is a global problem. Even if the research was performed in a respectful manner, it remains a concern if there is very little rigor in the research results.

Although there is much talk about the importance of research ethics and integrity, there is not enough education/training or role models. An important observation is the (old) observation: *who is training the trainers?*

One possible way to deal with ethics and integrity challenges is to design a research ethics and integrity basic scorecard – typical examples of questions to be considered will be: Why this research? What is new/novel in this project? Can experiments be repeated? Has anything been published on this topic? What is the link between resources used and envisaged outcome/s? How will it create new policy/influence

current policy? In Theme 7 we return to these questions when we take a closer look at research ethics and integrity.

These comments demand a deeper understanding of how we should educate our doctoral students. It is for this reason that we need to have a more encompassing view of doctoral education.

In this book, attention will be given to the scope of doctoral education, its processes and how research results serve a broader function than merely the finding of new knowledge. The next section reflects on the cornerstones of doctoral studies and education.

5. Cornerstones of doctoral studies and education

The following observations can be regarded as important cornerstones in building a framework that can contribute towards effective support for doctoral studies:

- *Doctoral supervision is also teaching and learning*. Very often supervisors overlook the necessity to be well prepared for formative assessment and to afford the student the opportunity to learn too. In return, students very often do not make use of the opportunity to learn from the supervisory experience, discussions and process.
- *Epistemological access:* Supervisors should create opportunities for students to unlock and comprehend the scientific basis of the study.
- *Knowledge generation and differentiation:* Postgraduate supervision should assist the student to create new knowledge, to place the new knowledge in the broader domain of scientific discipline and to make informed conclusions based on their research.
- "*Doctorateness*": The purpose of the doctoral study is to be unique compared to any other academic study. The thesis should give evidence that the student has addressed the research question, has mastered and applied the research methodology identified to support the research question, can demonstrate research competency, comprehension and skill and can provide evidence of new knowledge, understanding, interpretation and implementation.
- *Scholar in training*: Doctoral studies should be much more than simply the completion of a study. It is all about acquiring the necessary training to become a scholar in one's own right. Scholarship refers to intellectual craftsmanship, knowledge innovation and creativity, and the ability to make cross-cutting links, references, analyses and interpretations.

- Where is the "D" in the "PhD"?: The doctorate should be specific in focus. Research lacking valid research questions or appropriate methodology, repetition of known results and adding what is already available to a scientific community, shows an inherent lack of qualities associated with the expectations of doctoral study. Without an academic "punch line" the study will lack the core values of advanced research studies.

In the themes that follow, the many comments and observations made in this theme will be further unpacked and discussed.

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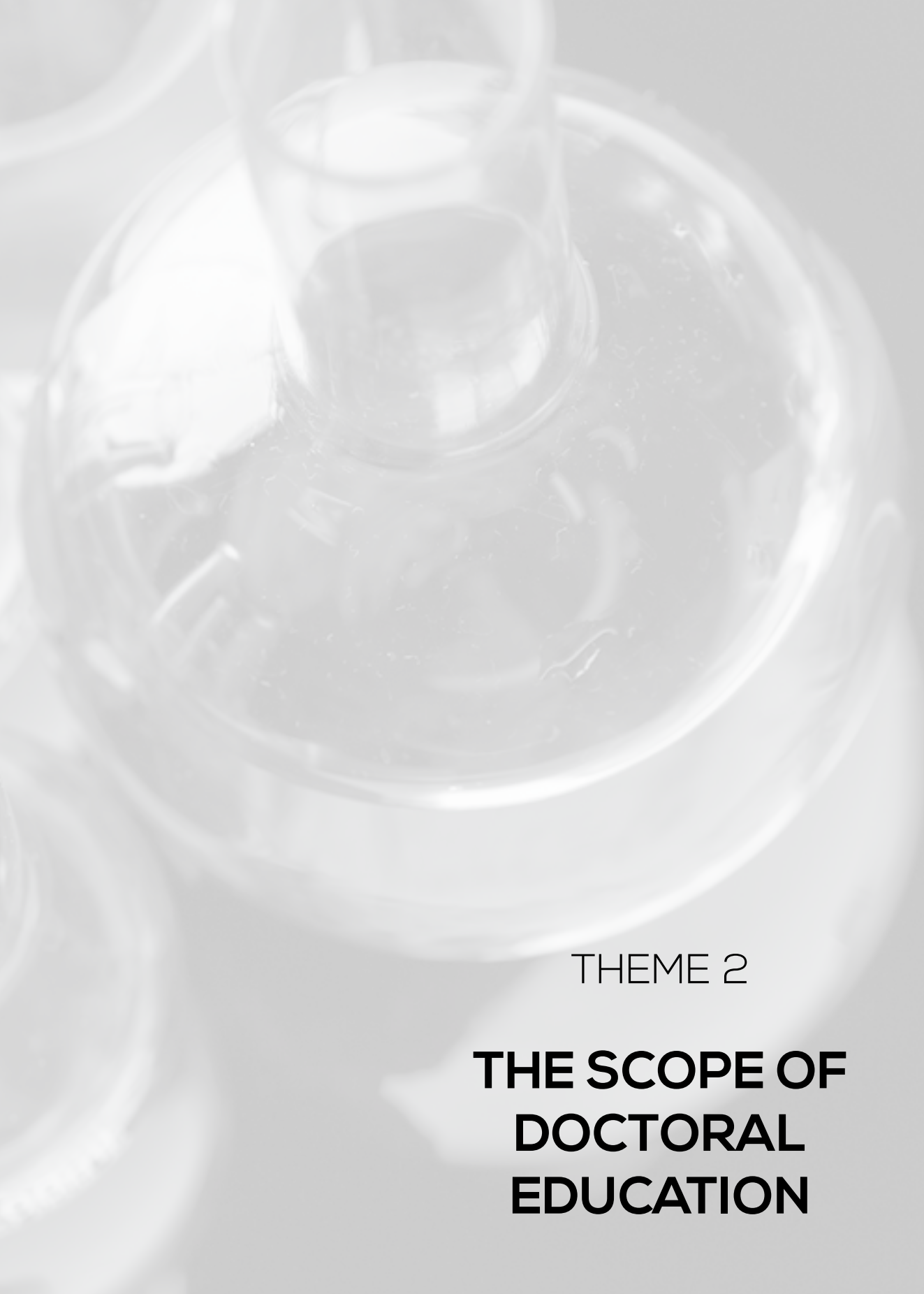

THEME 2

THE SCOPE OF DOCTORAL EDUCATION

RESEARCH: A MATTER OF DIGGING DEEPER ONLY?[1]

LAETUS O.K. LATEGAN

I can recall, from my years as a student, a comic strip in which a number of scientists were looking at their sophisticated computers and scratching their heads. Not one of the computers was operating. Should the computers be rebooted? Was it a virus? What had happened to all the data collected over so many years? Then, by chance, it was noted that the computers had no power supply.

I think, if I remember correctly, the "message" was that sometimes the solution to a problem is obvious (or is it?) This comic strip kept me busy for some time. How can you solve a problem without knowing what constitutes a problem? Hence, I realised that if you don't understand a situation or an activity, you experience a problem. But, and this was the moment of enlightenment, I realised that the more you deal with a situation, the better you will know and understand that situation and its challenges/puzzles/problems. I then became conscious of the fact that the kinds of questions we ask relating to the situation are very significant: is the question an expected one, or does it lead to something that really latches on to the imagination?

Solving problems is part of life. Problems can range from dealing with simple household activities to complex industrial applications. Research is a handy tool to help solve these problems. The word "research" originates from the French word "rechercher" which means "to go about seeking." From the origin of the word "research" it is evident that research is about searching, studying or investigating. (Re: search = regarding search!) This search is purpose driven and dedicated. You are looking, or searching, for something specific. This search is focused and specific. The search can be through literature, data, laboratory works, questionnaires, analysis, modelling, and so on. This search is what research is all about: to gain insight and knowledge about something that *does not yet exist* in the knowledge basis. This search is directed by the research

1 This paper is an updated version of a paper published by the author on the NRF's Emerging Researchers Network (www.nrf.ac.za).

question(s) asked. This search is the WHY and the WHAT of the research. It is the reason why one is doing this specific research project.

The research process is built on three major pillars: the problem, the evidence on how the problem is solved, and the conclusions that can be drawn from the evidence provided and from solving the problem. Looking at these pillars, it is evident that the problem is the reason for doing the research. I make it very clear to my students that if there is no research problem and ensuing questions, then there is no reason to do the research. The research problem is therefore the *raison d'être* (reason for being/existing) of the research project. Broadly speaking, a research problem can originate from the literature (existing knowledge on a topic) or from practice in business or industry.

In the attempt to identify the research problem, the question is often asked as to what constitutes a research problem. One must remain mindful of the fact that if something is a problem to me it may not necessarily be a problem for another person. *Something is a researchable problem when there is a gap in the existing knowledge basis.* This gap could be of a theoretical or a practical nature. Because of this gap it may not be possible to use the existing knowledge effectively. The purpose of the research problem is then to close this gap in the existing knowledge basis. It would not be unfair to claim that closing this gap should contribute to a significant development of the knowledge basis. I doubt whether one could really claim to have addressed a research problem if an obvious "missing link" in the knowledge basis were discovered, and nothing further was done about it.

Closing the gap essentially refers to discovery, innovation and creativity. One identifies something that was not previously known. It is as if one were to understand something for the first time. This discovery can never be presented in a conventional manner. It calls upon our imagination to understand the phenomenon, behaviour and/or developments in an innovative way. This is only possible if one is brave enough not to be limited by existing boundaries. I often ask myself if the researcher should not have "X-ray" eyes and an "X-ray" mind. What is needed, is a process of digging deeper than what is obvious on the surface.

An important directive in solving a research problem is to have a comprehensive understanding of what the literature (as a collection of all documented discoveries and knowledge) says or doesn't say about the problem. The more one reads about the problem, the better one will be able to phrase the research problem. Part of identifying the research problem is also to understand what the research problem is

all about. It is not enough to have a problem only; one should also unpack what the problem is about. The more one understands the complexity of the research problem, the more one will be in a position to draft an appropriate research design on how to solve the research problem. The research problem is linked to the research question(s) asked. Asking a research question follows on scientific curiosity – one wants to know more about something that is not yet known. To do this you should be willing to travel into unknown territory in the knowledge domain. It is for this reason that the emphasis is on creativity and innovation. Creativity and innovation mean that one is daring enough to take the proverbial "road less travelled".

This orientation demands a specific behaviour. Some years ago my mentor and I were discussing the development of a researcher. He told me that research is never about digging over but rather about digging deeper. To me this meant that one should not only know more about what is already known (simply extending the knowledge basis), but that one should wander off into unknown territory (deepening the knowledge basis). This discussion was later harmonised when a colleague and I discussed what is essential in doing research. We concluded that it is acceptance of the fact that you don't know but are willing to learn. This is often the limitation with many researchers: we are not always willing to acknowledge our limited understanding in what we call our "field of expertise". In addition we are sometimes hesitant to accept that closing the gap symbolises a jump into the unknown. You know you will land but you are not sure when or how. (Research is like having a blind date with the unknown, one colleague stated.)

Solving research problems therefore has more value than only scientific value. Solving the research problem should also assist a researcher to create new knowledge that can be added to the existing knowledge basis.

It would, however, be a limitation to confine research to solving a problem only. This became evident after I engaged some colleagues and students on this matter. From that dialogue, two interesting views can be added. Firstly, research is about curiosity (I want to know more), creativity (things can be said differently, new views can be presented, more ideas can be added) and a commitment to the scientific community to grow the discipline. Secondly, the research assignment is more robust: it wants to shift boundaries and seek patterns of similarities across the knowledge base.

As the years passed, I keep on pondering on this idea. It was at a Consortium for Higher Education Researcher's Conference (Lisbon 2015) that the purpose of research

was very eloquently summed up by Alexandre Quitanlina (Emeritus, Porto University, Portugal). In his keynote address, he said that new knowledge is built on curiosity and imagination. Narratives are important for sciences – and not only for the soft sciences. He unpacked this comment by asking whether the "story" is coherent or fertile. Do our "stories" invite new questions or are these stories ignorant of societal challenges? It is great science if we ask new questions – if we are not satisfied with answers provided before. Another metaphor that can be added is that science is a puzzle – research is necessary because some pieces are missing.

In summary, one may refer to the researcher as a detective in scientific mysteries. You are like a modern day Sherlock Holmes. You want to solve problems. Nothing should escape the attention of the researcher.

All these different activities and attitudes contribute towards a more comprehensive understanding of what the research problem is all about!

WHERE IS THE "D" IN THE "PhD"?[2]

LAETUS O.K. LATEGAN

For many years now, I have been looking into what constitutes a PhD study. For example, the Higher Education Qualifications Framework outlines specific outcomes for doctoral studies. These outcomes direct towards scientific accomplishments (mastery of subject knowledge and contribution to the creation of new knowledge), communication and transfer abilities (in command of scientific language, presentation of results to an audience and publication) and educational skills and competencies (supervising students). In addition, all universities have summative assessment criteria for PhD studies. A random selection of criteria from South African universities suggests an outcomes-based approach founded on evidence of the following broad based activities: research design and methodological consideration, literature review and the triangulation of data (qualitative, quantitative and empirical), analysis of findings and drawing of conclusions. In addition reference is made to language, technical presentation of the study and relevance.

In analysing the two resources (HEQF and institutional assessment requirements) a number of observations can be made. First, the thesis should give evidence of a number of accomplishments. Second, it is clear that, alongside the mastery of scientific practices, comprehension of skills and acquiring of competencies are also required. What is not said, although implied, is that the PhD candidate should master scholarly activities. The question then, is: what are scholarly activities? A literature review suggests that it is knowledge wider than subject specific knowledge; it is participation in peer reviewed research activities; and it is the articulation of an opinion that is respected by peers. Three specific references can be highlighted: *scholarly review* as opposed to conventional literature review, identification of *patterns in the knowledge basis* instead of the "silo" understanding of disciplines and the creation of *identifiable intellectual property (IP)*.

2 This paper is an updated version of a paper published by the author on the NRF's Emerging Researchers Network (www.nrf.ac.za).

Allow me to substantiate these references. A scholarly review should not only repeat (read "say") what other researchers have already placed in the public domain. A scholarly review should show comprehension of the debate on the particular topic, reflect on what is already known about the topic and frame the existing views against paradigmatic differences, the philosophy of science and theory building. The scholarly review is a *vertical* contribution to science: *You are building a new case for the identified problem/reason for the research.* With regard to the comment on knowledge patterns, it is quite fashionable to move away from mono-perspective research to multi-, inter- and transdisciplinary research. The advantage of this approach to research is that new knowledge patterns will be created to open a new understanding of society and its challenges. Is this not the reason why we are doing research? We want to shift the frontiers of our own understanding; we are embarking on an unknown journey but we do it because it will affect change in ourselves and in our world. This shift warrants creativity and innovation. The emphasis is less on what is known and more on what can be discovered, how it can be discovered and what new possibilities can follow from the discovery of new knowledge.

Whilst we are doing all of these, we are reminded of the knowledge economy. Knowledge is like a raw material – you can fabricate something new based on your newly gained knowledge, that can compete in the open market. We have learned that knowledge has economic value too. To be a researcher in the context of the knowledge economy means activities beyond the academic domain leading to, for example, technology transfer and innovation, IP recognition and commercialisation. This should be equally true of the PhD study: It should not be unrealistic to expect this from the next generation of researchers.

This discussion on the "PhD" relates to a broader discussion on what is known as "doctorateness". "Doctorateness" is not only about the scope of the work but very much about the level of engagement and the scholarship reflected through the research. Following from these observations and comments, the question now is: what exactly is expected of the PhD? What makes a study truly a doctoral study? Can one argue that the requirements outlined above are sufficient? There are a number of fundamental activities constituting a PhD. These activities, with their outcomes and evidences, are outlined below.

- The PhD should give manifest scholarly rigor – this is reflected through the debate, reflection, arguments, conclusions and evidence on how the existing boundaries in the specific scientific discipline were shifted. The study should contribute towards

theory, application and policy formulation. A PhD is not simply another study. In essence it is all about how the PhD candidate participated in the scientific domain. Remember, this study is regarded by many as your "application" to become part of a scholarly community.

- A gap in a scientific problem should be closed and new knowledge should be added to the existing knowledge basis. The PhD is not meant merely to extend/add to what we already know. To add more information on what is already accepted by a scientific community will not open the opportunity to grow the knowledge basis. Doctoral research is about growing the discipline.
- An essential aspect of the PhD study is the communication between the different parts of a study. It is important that the PhD candidate asks questions and finds answers as he/she is progressing with the study. Typical questions will be: What is my research problem/reason for the research? Will this method deliver on the hypothesis? Is a different understanding/interpretation possible? How will this conclusion shift the boundaries of my discipline? Are the conclusions really adding value to the existing debate? The PhD candidate should also constantly keep an eye on what the study is all about.
- Peer reviewed publications and conference presentations should follow during the research stage and also after the completion of the study. The PhD candidate should participate in the acknowledged research activities of a discipline. Through scientific writing and presentation, the PhD candidate can start making a contribution towards the field of study.

Identifying the core of the PhD study – what I refer to as the "D" in the "PhD" – suggests not only a commitment to the study but also constructive support for the candidate. The supervisor for the study should advocate the HEQF requirements, commit to the education of doctoral candidates, and keep on asking questions of the candidate and the study in order to shift the existing boundaries of the discipline.

During one of the discussions at the fourth Biennial Postgraduate Supervision Conference organised by the Centre for Higher and Adult Education at Stellenbosch University, I picked up a beautiful metaphor. Reference was made to blowing up a balloon. The PhD study can be compared to this action. The study is not only about blowing up the balloon but also about examining how the balloon can be expanded beyond its known capacity. This presupposes familiarity with the research field; an illustration of knowing what can and what will be tested; creativity to realise new opportunities; and the experience to accomplish all of them without putting the research or its results at risk.

At the same conference I was looking for the "D" in the "PhD." The same metaphor was employed to argue that the core of the PhD is not about blowing up the balloon, but about knowing when to stop blowing – just before the balloon bursts! This is a trademark of a true scholar.

THEME 3

THE PLANNING, MANAGEMENT AND ROLL-OUT OF THE RESEARCH PROCESS

THE RESEARCH PROCESS

LAETUS O.K. LATEGAN

Over the years I have noted that students ask specific questions with regard to the research process. The following are the ten most frequently asked questions in research. Think about these questions in relation to your own research. Then ask yourself how a particular activity will contribute to your research project. Then evaluate your progress against the following questions.

Table 1: Frequently asked questions in research

No	Activity	Application to your research	Progress
1	What is your research problem all about?		
2	How do you use the literature to support your research?		
3	What is your research method and what does the research methodology entail?		
4	What is the purpose of the protocol?		
5	How do you write up your research?		
6	How do you assess your own research?		
7	How do you view supervision and mentorship?		

8	What is the role of postgraduate assessment?		
9	What three valuable lessons have you learned so far in your research?		
10	How do you take your research to publication and presentation?		

As stated in Theme 2, the research process is built on three major pillars: the *problem*, the *evidence* on how the problem was solved and the *conclusions* that can be drawn from the evidence provided and from solving the problem. When I consider these pillars, it is obvious that the problem is the reason for doing the research. I tell my students clearly that if there is no research problem and ensuing questions, then there is no reason to do the research. The research problem is therefore the *reason for the existence* of the research project. Broadly speaking, a research problem can originate from the literature (existing knowledge on a topic) or from practice in business or industry.

> In dealing with the research process, I have observed that postgraduate supervision must guide the student towards having a broader understanding of the research value chain. This necessitates the importance of doctoral education as part of any doctoral study.

Doctoral education and postgraduate supervision are well-known concepts and activities that address the learning and training needs of the doctoral student. The purpose of these activities is to teach the student to comprehend and master the different challenges posed by the research agenda and process. What is also needed however, is for the student to have the knowledge, skills and competencies to engage with *all* the stages of the research process linked to the research value chain. The scope here is to comprehend the various stages of the research process, ranging from problem identification to problem solution, and from problem solution to innovation and incubation that will lead to product development and commercialisation. My suggestion is that doctoral education should also include how the end-user (which refers to various communities – business, industry, government, social communities, etc.) can benefit from

the research (public accountability). The argument in support of a broadened scope for doctoral education is based on the perspective that methodological understanding only is not sufficient to assist a researcher in meeting the expectations of a research project. [For a detailed discussion see Lategan (2008) and Lategan (2014)]. In this book the focus will be on this extended focus for doctoral education.

Figure 1 is representative of the research process and its concepts should be mastered by the doctoral student. The supervisor has the responsibility to assist the student to master the different stages of the research process in order to be successful in his/her research.

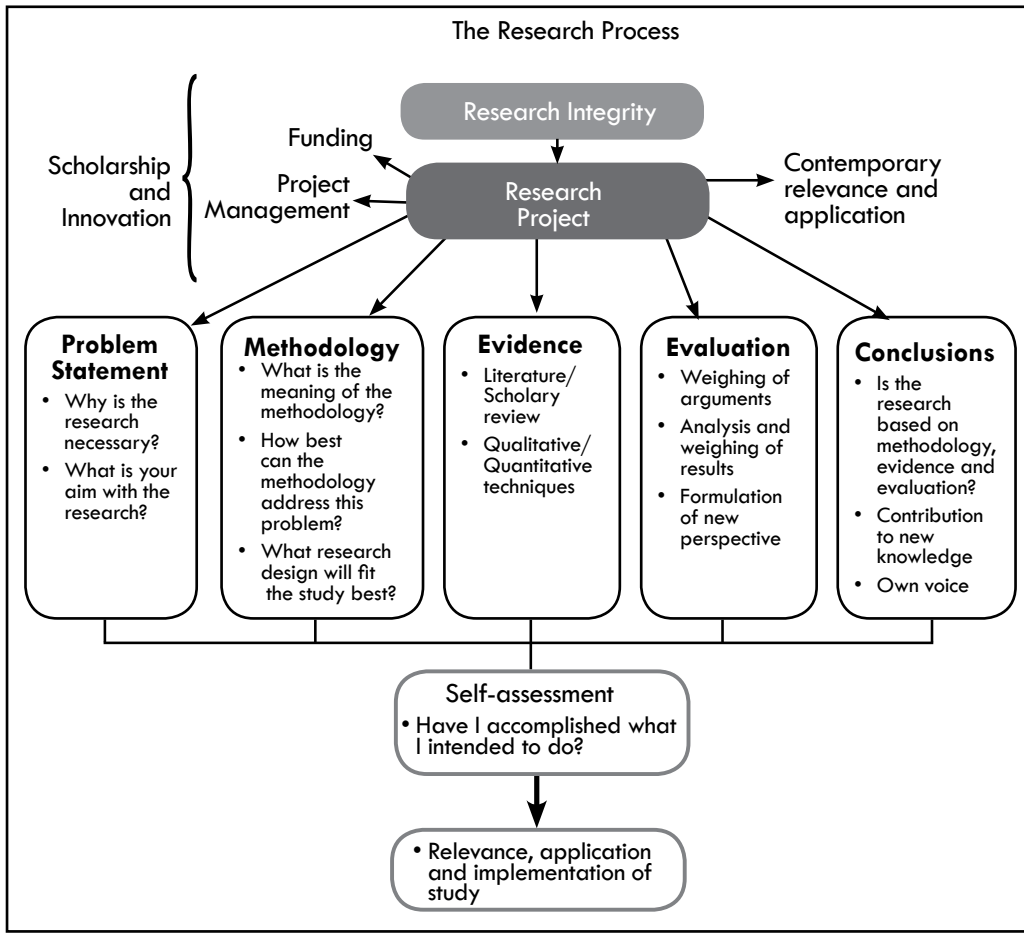

Figure 1: The research process

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MANAGEMENT AND PLANNING[3]

ULRICH HOLZBAUR

1. Management and planning central to research

Management and planning is ubiquitous to research: an important part of research is project oriented, but strategic planning of the research value chain is even more important for success. Management skills are therefore essential for the success of any researcher (Holzbaur, Lategan, Dyason & Kokt, 2012).

Hence, management is an important part of doctoral education: researchers must learn how to plan a project, how to deal with the uncertainties of project work and how to bring a project to a successful conclusion in order to impact upon future work and the real world. The supervisor must be in the position to define and assess the research project strategically and to plan the forthcoming research projects.

The research cycle needs management to ensure successful and effective planning, as well as acquisition and completion of research programmes and projects. For the needs of the knowledge society it is not sufficient to just "do research" or to do research for the sake of doing research. Future researchers need to be able to plan the research value chain, the research strategy and research projects.

In this section, we address an important management aspect of doctoral education, which is *the process of* managing *future researchers who will actively* manage *the research process*.

We describe the methods needed to plan and to develop planning skills in the context of doctoral education and the research value chain.

3 The work to analyse the role of projects for educating students was supported by the Baden-Württemberg Department of Science, Research and Culture (MWK) within the programmes "Professionalization of higher education" in the project "Learning via Projects – Systematization of Project Learning" and within the project ESPRESSO – Experience Science and Practical Relevance and learn Sustainably via Sustanability projects" in the programme "welcome to science".

The reason is twofold:

The process of research education needs to be planned and managed. It is more than project management: it´s also about the relation between the future doctors and their mentors.

Doctoral education is not only about science, it´s also about planning and managing. This must be considered in the long term scale of self-development, career planning and programme management and on the operational scale of managing oneself, the goals, the projects, the research team and the resources. It´s also about leadership (Holzbaur 2007).

2. Orientation

Within the scope of this book on doctoral education with its wide span from the self-development of the future researcher to the developmental activities of supervisors and mentors, management plays an important role. The most important part of management is strategic planning.

Researchers must learn how to plan a project, how to deal with the uncertainties of project work and how to bring a project to a successful conclusion in order to impact on future work and the real world. The researcher must be in a position to define and assess a forthcoming research project. Doctoral education must not only teach project management but also organisational skills and leadership.

According to Drucker (1966) the main criterion of a manager is the contribution to the success of the enterprise. Hence, we see management in a more success and outcome oriented context than the usual definition of "getting things done by other people". Management means to plan the development and allocation of (human) resources to achieve success.

On the basis of these perspectives, the following definition for doctoral education can be offered:

*Doctoral education is the process of **managing** future researchers who will actively **manage** the research process along the whole research value chain.*

3. Managing research

One of the basics of research management is the understanding of the research value chain and its implications for management. The research value chain focuses on the research outcome which means results and publications (for the scientific community), transfer and innovation (for the economy) and also interdisciplinary outcomes and innovation (for society). (See Theme 6 for how this links with the learning factory.)

4. Managing research projects

Projects are inherent to research and should be integrated as part of doctoral education for two reasons:

- Goal-orientated projects are aimed at a dedicated target, e.g. a scientific result. These projects do not differ from projects in industry.
- For education-orientated projects "the journey is the reward", which means that the main goal is to learn something within the course of the projects.

5. Managing the research process

When we talk about managing research, we generally think about classic research projects defined by the classic project criteria – aim, resource, funding and time. Such projects are usually defined:

- by the activity – e.g. as a survey or some measurement,
- by the resource – e.g. a student's thesis or a measurement programme on a special apparatus,
- by the resource – e.g. a grant from a national institute, or
- by the time – e.g. a half-year's grant from a national institute.

The expected outcome is usually defined in the beginning, for instance within a research proposal or an application for a grant. Most often, the way and even the expected result is quite clear at the beginning and all of the methods of project management can be applied. The project triangle will be the basis for defining, monitoring, control and evaluation of the research project.

6. Strategic planning

Strategic planning is long term planning, taking into account the possible changes in and potential reactions of the environment.

This includes the consideration towards the long term and overall aim of the research process, including knowledge management and the human resource aspect, which mainly means the relationship between senior and junior researcher.

Two important factors for strategic planning are:

- Mega trends: Mega trends influence the importance of research results for society, politics and industry, and therefore also the public perception of and the funding for research.
- Competition: Although researchers may not see themselves as part of a competitive environment, there is competition on a personal basis (career planning) and also with respect to research results: it´s only the first one that counts!

7. Project management and leadership

All researchers are involved in some managerial activity, especially in projects management. Project management itself is a good example of Drucker´s definition mentioned above, since project managers have to lead and to ensure results rather than try to create organisational structures. Very often, the members of a project team are part of an organisational structure in which they report to a person other than the project management as such. This may be to a Head of Department or to a Manager or a Service Unit in the University, who may be independent even from the project manager´s Dean. Project managers must lead their team without the formal authority of a line manager.

8. Project management and project manager

A project is a well-defined activity that is unique (not a routine task). This means that the project has a specific aim and therefore is limited with respect to its duration.

Project management makes a number of methods available for performing research successfully.

- Timeline planning, phase concepts, milestones, network scheduling techniques;
- task structuring and resource planning, work breakdown structure, project and communication structure; and
- project controlling, reporting and documentation.

9. Project managers and leaders

The central person in project management is obviously the project manager. Sometimes there is a differentiation between the external project supervisor, sponsor or facilitator (providing resources and reporting to top management or stakeholders), the internal project leader (being the head of the project, responsible for overall targets and decisions) and the project manager (doing the detailed planning and controlling).

A project manager's task, in contrast to that of a line manager, consists of:

- thinking in terms of results and phases, rather than time periods and sequences;
- being able to deal with uncertainties and handle planning time variables;
- being able to lead team members, even when he/she is not their superior;
- setting and discussing targets with stakeholders (customers, management, supervisor); and
- preparing, planning, evaluating, and organising unique assignments.

The success factors for any project manager lie in an overall combination of:

- expertise: knowledge of the field, the matter at hand, and the facts,
- methodological competence: methods, applications, problem solving ability,
- social competence: dealing with people, responsibility, and assertiveness,
- personal competence: personality, motivation, and self-management.

This also applies to a researcher working on his/her own, as project planning is also necessary for one-person projects, and cooperation is necessary in almost all research projects.

10. Project management essentials

The scope of this contribution does not include teaching project management. Nevertheless, we summarise those aspects of project management that need to be included in educating doctoral students (Holzbaur & Bühr 2015). These elements are:

- the project triangle
- work breakdown structure
- Gantt diagram or network scheduling
- controlling, e.g. via
  - milestone trend analysis and
  - earned value analysis

Project triangle

The (magic) project triangle or triad is formed by three corners, each representing one of the project determinants. The corners of the project triangle are:

- **Q = Quality, result (qualitative and quantitative)**
  - vision and aims: desired final status, project result
  - creation of value: positive contribution of the project
  - quality: measure of achievement, product quality
- **R = Resources**
  - money: cost of resources obtained on the free market, or from internal cost accounting
  - time: working time, product or staffing time
  - staff training, knowledge, motivation, availability
  - hardware, software, infrastructure
- **T = Timeline**
  - time: calendar time (months, days)
  - timelines: precision, probability of time overrun

The work breakdown structure

Project planning is based on a work-package structure (work breakdown structure, WBS) and on milestones. Networks and cost estimates are based on this WBS. [For detailed descriptions and templates, see Lategan & Holzbaur, 2009.]

The WBS describes the total task and divides it in a hierarchical way into small work packages. The term 'work package' (WP) is sometimes only used to refer to the lowest, irreducible level of the WBS but in fact it also applies to the summary tasks. This makes sense since in the course of planning and successive refinement, any work package can be divided into several sub-packages.

The WBS can be used for:

- resource planning;
- delegation of responsibility (assignment of subtasks); and
- creation of a network schedule based on the tasks.

Work packages for doctoral research

For academic studies, the same principles apply as for other projects. However, since the study usually culminates in a written paper, work has to be structured to fit this goal. The entire study to be performed within the project must be broken down into work packages. In doing this, the above-mentioned criteria must be borne in mind.

Generally speaking, the WBS in research projects is based on the phases of the project, i.e.:

- Literature study
- Planning: idea, experimental planning, concepts
- Preparation: implementation, experimental setup
- Execution: experiments, tests, survey, calculation
- Evaluation, tests and verification of results
- Formulation of the results

11. Education for research management

Young researchers want to do research – not management. They associate management with presentations and forms, reporting and accounting.

A successful researcher must manage, however. Excepting for certain theoretical concepts that could still perhaps be developed by a particular genius, science needs the work of many people. Applied and empirical science especially, need cooperation in multi- inter- and transdisciplinary teams. To lead a team is the core to success in research.

Of course, there are various aspects of management that have different levels of attractiveness and challenge for the researcher, although they are all necessary. Some of these management aspects are:

- administration
- budgeting (i.e. planning of financial and monetary aspects)
- controlling (i.e. reporting and making the management feedback loops work)
- staff development
- delegation

- organisation
- communication
- stakeholder management
- evaluation of team results and individual performance
- writing applications and reports
- reporting
- presentation of research results
- public relations and press releases
- zero-based budgeting as an effective means of planning
- fostering entrepreneurial skills
- entrepreneurial activities i.e. investment in the future
- strategic planning
- organisation and coordination of work
- work breakdown as a basis for detailed planning
- proposal writing
- self-development
- education and training for staff and oneself

12. Competence building for research

Areas in which competence is built up gradually from secondary school to the level of first year students, to a professional level inside or outside the university comprise the following:

- Insight into the reasons and criteria for scientific work.
- Attitude towards systematic analysis and the creation of new reliable knowledge. Literature work and referencing, attitudes towards intellectual property.
- Project management competence, methods, tools and attitudes in planning, administration and controlling; leadership and team management.
- Communication skills and systematic reporting. Teamwork and social competences such as reliability, accountability and trust. General professional competences such as managing, auditing, assessment, writing reports.
- Linguistic proficiency and foreign language proficiency in literature studies; written documentations and oral presentations. Sensitivity to definitions and the use of notions and notations in science.

- Quality management competences. Insight into the importance of quality; and motivation and skills for the implementation of excellence in enterprises and projects.
- Knowledge of statistical methods for estimates in project management and science, e.g. qualitative and quantitative descriptive methods; statistical decision methods (hypotheses testing) and their limitations and risks.
- Competence in basic methods of research such as experiments, questionnaire development and usage, model-based working, understanding the problems of verification, validation and falsification.
- Basic mathematical competence, especially in working with scales and dimensions, using formal logic, estimating and assessing orders of magnitude, using formulas correctly, analysing graphs.
- Special subject-oriented methods and knowledge.

13. Doctoral management education

Just as in any other educational process, there are several actors involved in the process of doctoral management education, namely the person him/herself (self-development), the persons formally involved with the person´s development (formally assigned supervisors, line managers, study leader, formally assigned mentors), and also, importantly, the people who influence the educational process in an informal way. Amongst these are the people that we call peers, mentors, lecturers, research managers, innovation managers, presenters at training courses and conferences, media and, last but not least, the university itself and its culture.

There is also a great deal of influence from other activities and organisations, especially with respect to management education. The young researcher or postdoc learns from his or her management activities in other organisations and within the organisational structure of the university. The activities can be manifold: organising an event, editing a book, taking responsibility within the community, working for a volunteer organisation or doing regular volunteering duties will impart a great deal of experience and will deepen insight into management and leadership principles. In the process of research education any such experience must be seen as having a positive impact. Hence, supervisors should support any activities by means of which the future researcher can develop leadership, planning skills and responsibility.

Finally, of course, the supervisor, line manager and any other educator should educate by example.

In order to act, there are four prerequisites:

- Knowledge – the facts and consequences: "I see that it is".
- Ability – the necessary skills: "I can".
- Attitude – the decision and drive: "I will".
- Freedom – an environment that does not prohibit the action: "I'm allowed to".

There are also several soft factors that are necessary prerequisites for a risk-taking attitude and for premium achievements in research: skills, ethics and motivation.

14. Projects as a means of doctoral management education

Educational chain and stairway

Areas in which a competence is built up gradually from secondary school to first year student to professional level inside or outside the university comprise the following:

- Insight into the reasons and criteria for scientific work; attitude towards systematic analysis and the creation of new reliable knowledge; literature work and referencing; attitudes towards intellectual property.
- Project management competence; methods, tools and attitudes in project planning and control; leadership and team management.
- Communication skills and systematic reporting; teamwork and social competences such as reliability, accountability and trust; general professional competences such as managing, auditing, assessment, writing reports.
- Linguistic proficiency and foreign language proficiency in literature studies; written documentations and oral presentations; sensitivity for definitions and the use of notions and notations in science.
- Quality management competences: insight into the importance of quality; motivation and skills for the implementation of excellence in enterprises and projects.
- Statistical methods for estimates in project management and science, e.g. qualitative and quantitative descriptive methods; theory of errors and statistical decision methods and their limitations and risks.
- Basic methods of research such as experiments, questionnaires, and model-based working; understanding the problems of verification, validation and falsification.

- Basic mathematical methods especially working with scales and dimensions; using formal logic; estimating and assessing orders of magnitude; using formulas correctly; analysing graphs.
- Special subject-oriented methods and knowledge.

The metaphor of a stairway (Holzbaur, 2006) is adequate to describe the various skills needed to do research, as well as the steps to be taken in research education.

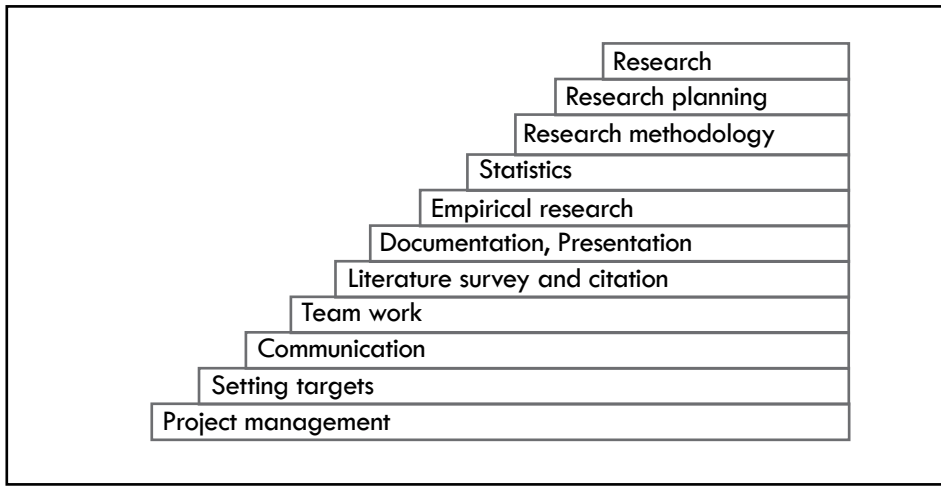

Figure 2: The stairway of research skills

15. Prepared projects method

Over the past decade, the prepared projects method (PPM) has been developed and refined at Aalen University (Holzbaur, 2008). This method integrates several approaches to increase the success and educational impact of projects:

- Use projects to provide real world experience for the learners and to give them hands-on experience of stakeholder interaction and teamwork.
- Define and prepare projects which have real-life training effects for the students and a positive impact on university and community development.
- Treat projects like management games with an intensive preparation phase, which ensures that the projects have a good training effect and a very high chance of success.
- Compile the projects of each module and each semester to cover all relevant subjects of the module.

The task of defining goals and setting targets for the project is an important part of education towards research and project management. Traditionally, in an education environment, projects are defined by giving a task to the learners. The mission has to be accomplished and some items of a predefined minimum quality have to be delivered. As with a research proposal, students in a project should submit a project outline that comprises vision, mission, scope and deliverable items for the project, which must be agreed upon by the stakeholders. This will guarantee students´ involvement in their own project. Moreover, it trains them to define the goals in cooperation with the customer and the teammates. This process of defining the project has been analysed within the framework of the magic triangle (Holzbaur, 2006). In the context of research education, we also have to consider the question of an adequate level of research and creation of new and reliable knowledge. If the benchmark is set too low, the result will not be sufficient for anybody. If the benchmark is set too high, the risk of failing increases.

Whenever a task is given to a student, the supervisor should have a rough estimate of the amount of effort that will be involved.

16. Benefits and challenges of projects

Throughout the years, we have had discussions and evaluations of the projects that have been undertaken, and we have shown that, while they create good learning experiences, they also create challenges for the students with respect to their social skills and time management.

The most important benefits are:

- encouraging of teamwork and integration of the students into a team;
- the feeling of achieving relevant results;
- learning by doing; and
- seeing the relevance of the learned information.

The most important risks are:

- individual students who are trying to pass with little engagement or who leave the project;
- team leaders and (more seldom) members who invest too much time and neglect other courses;
- lack of communication between project team and stakeholders.

General success factors of students´ projects are:

- mutual benefit for the stakeholders and the university;
- trust among all partners;
- detailed planning and preparation of the projects;
- assignment of the projects to teams in a way that allows respect for students´ preferences;
- supervision and support for the students´ teams by university staff and senior students; and
- publication of the results as part of the project scope.

17. Projects as a challenge for supervisors

The supervisor is also challenged by the use of the project method, as it deviates strongly from traditional classroom teaching. The most important requirements are that:

- project subjects must be defined and pre-planned to contribute to the learning success;
- projects must be prepared in a dialogue with the project customer (stakeholder) in order to become useful;
- the set of projects in a class (project portfolio) must be defined to cover all relevant module subjects (knowledge, skills);
- project aims must be calibrated to become viable and challenging;
- the supervisor must be able to define and plan projects and to assess and calibrate them with respect to the workload;
- during the project phases, the educator must take on several roles, from that of project enabler to supervisor and examiner (Holzbaur 2006);
- due to the challenging timeline of semester projects, students need immediate responses to problems in the project.

PPM can be used to achieve several results simultaneously:

- to train project management and research methodology,
- to teach practical aspects of any course subject,
- to gain tangible results in real world projects.

18. Conclusion

In this theme we have discussed the relation between management and doctoral education. The doctoral student will realise that no study or project can be successful without understanding and applying the basic concepts of project management. The doctoral student should apply the principles outlined in this theme to secure success in the management of the research project.

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GROWING YOUR RESEARCH SKILLS AND COMPETENCIES

DESERÉ KOKT

1. Getting into the research mode

A tool box normally contains a variety of instruments that can be used to perform all sorts of different tasks; a screwdriver, for instance, is used to drive in screws, or a pair of pliers can be used to grip something with. A tool box needs to be checked regularly to make sure that all the relevant tools are there, and new tools on the market can be added, so that any actions and activities can be performed as needed. The same principle applies to doing research. Prospective researchers should realise that they need to equip their "tool boxes" to enable them to expand on their research-related knowledge and skills. Existing and also prospective doctoral students often do not realise that the acquisition of research skills and competencies does not happen overnight: it is a process of growth that requires dedication and perseverance. The attitude of students, therefore, should be one of willingness and flexibility in the quest to acquire new skills and competencies.

With this in mind it is imperative that prospective doctoral students make a conscious decision about what it is they want to achieve. As doctoral study is usually about obtaining a higher qualification, this will automatically imply the acquisition of more advanced skills and competencies. It is thus imperative that doctoral students find a suitable study leader to guide them through the learning process. Students can also identify a mentor, besides the study leader, who can assist them during the doctoral journey. As a doctoral study often involves one-on-one interaction with a study leader or mentor, it is imperative that a congenial relationship exists between the various parties. It is also important that a good relationship be maintained throughout the duration of the study to ensure that students learn the appropriate skills and competencies expected of someone with a higher qualification.

As the research process is usually linked to solving a particular problem, students should view this as a project that may last for a two or more years. It must have a commencement and a completion date. Students often fail to see the bigger picture and only concentrate on the smaller sub-sections – which limits their comprehension of the entire process. Students should also view their research as an opportunity to make a contribution to science by solving a particular problem. This also applies to the writing of scientific papers. Through science writing the researcher conveys the research to the scientific community. It is thus imperative that any scientific paper have a clear aim and problem statement followed by a comprehensive literature review that addresses the stated problem. If a paper has an empirical section the data gathered must relate to the literature and should either add to the literature or provide a new perspective on what has already been found by other researchers. The reason for selecting a particular research methodology should be well motivated and the methodology clearly explained. It should be borne in mind that once a researcher submits an article to a science journal, its contents will be reviewed by peers – which implies that the level of argumentation and reasoning should be scientific and up to standard.

2. Research skills

The point is simple: no doctoral student can be without research skills. Research skills can be defined as a person's ability to master research activities at the levels of doing research, developing research, transferring research and managing and administering research. These skills relate to what is commonly known as the professional research development chain. In short, important milestones in the obtaining of research development skills are: mastering skills to do research – improving qualifications – managing and administering research – presenting and publishing research – supervising research – grants – technology transfer – participating in research community – ongoing improvement.

Important observations are that (1) some activities follow on other activities, (2) some activities run parallel to others, and (3) the research development chain is incomplete without a range of activities.

In essence, there are four levels of research skills:

- Skills for doing research: research design, problem identification, research methods, study and application, literature review, scientific writing, research ethics and integrity, grant application, supervision, etc.

- Skills for developing research: knowing the research environment, needs analysis and growth plan, ethics and integrity, project planning, publishing and presenting research results, etc.
- Skills for transferring research: innovation, incubation, patenting, IP, commercialisation, etc.
- Skills for managing and administering research: management, administration, project management, etc.

The contemplation of these skills lead spontaneously to questions such as:

- What skills do you need to do your research?
- What is the relation between these different levels of research skills?
- Are the levels hierarchical?

Following from these questions, one should ask: Do I have a growth plan for my research? Depending on your plan, you may require a different range of research skills.

3. Research competencies

Research competencies involve qualities a student needs to successfully complete a doctorate. This will imply sound theoretical knowledge and understanding of the topic, together with sufficient practical experience to be able to complete/carry out the task concerned independently and without assistance. Being competent in something is different from merely being familiar with something (having a basic understanding but little or no practical experience or having knowledge of something, or having a sound theoretical knowledge but limited practical experience). The required competencies will be different for the different stages of the research career.

4. Making it practical

Reflect on the research skills indicated in Table 2. Decide whether you possess the skill or not and reflect in the last column on how you will develop the skills you do not possess.

Table 2: Assessing your research skills levels

Research skills	I possess this skill	I don't possess this skill	Developmental plans
1. I have good verbal communication skills.			
2. I have good science writing skills.			
3. I am able to formulate appropriate arguments based on literature.			
4. I am able to attend to the technical, grammatical and linguistic requirements expected from a doctoral student.			
5. I submit quality work to my supervisor(s).			
6. I am able to verbally present my research results at seminars and conferences.			
7. I can persist, even if there are challenges with my doctoral studies.			
8. I have good reading skills.			

Research skills	I possess this skill	I don't possess this skill	Developmental plans
9. I can motivate myself.			
10. I read my work thoroughly before I send it to my supervisor.			
11. I liaise and network with other doctoral students both inside and outside my institution.			
12. I am able to cope with the administrative tasks associated with my doctoral studies.			
13. I keep up-to-date with the latest development in my field of study.			
14. I maintain good relationships with my supervisors.			

Reflect on the research competencies mentioned in Table 3. Decide whether you possess the competency or not and reflect in the last column on how you will develop the competencies you do not possess.

Table 3: Assessing your research competency levels

Research competencies	I possess this competency	I don't possess this competency	Developmental plans
1. I maintain a high level of professionalism.			
2. I am creative and innovative in my research endeavours.			
3. I have the ability to plan and coordinate the research activities associated with my doctoral studies.			
4. I have up-to-date knowledge about my study area.			
5. I comprehend the research process from stating the problem to finding the solution.			
6. I have the ability to manage and improve my own performance.			

Research competencies	I possess this competency	I don't possess this competency	Developmental plans
7. I have adequate knowledge of the research processes and systems in my institution.			
8. I support the development of research capacity and skills offered by my institution.			
9. I am able to place my work in the public domain through presentations, publications and reports.			
10. I am able to identify and facilitate opportunities for research commercialisation.			
11. I am ethical in my research practices.			
12. I support diversity and equality.			
13. I am fully acquainted with the research focus areas of my institution.			

Research competencies	I possess this competency	I don't possess this competency	Developmental plans
14. I am able to identify and facilitate opportunities to obtain research funding.			
15. I am able to apply appropriate research methodologies in addressing the research problem.			
16. I can interpret research findings, be they qualitative or quantitative.			

5. Conclusion

This chapter highlights the importance of developing the research skills and competencies of doctoral students. It is important to note that such skills and competencies develop as the student progresses along the doctoral route. Progress can often be tedious and complex, requiring huge amounts of persistence and deliberate action from students. Pablo Picasso once stated that "Action is the foundational key to success" (Brainy Quotes, 2016) – which certainly fits the topic of this chapter.

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PRACTICAL EXAMPLE

Rolling out the doctoral project

KOBUS VAN DER WALT

1. Aim of the contribution

This example describes the research supervision system that was developed in a faculty of engineering but is relevant to other disciplines as well. The aim of the contribution is to help supervisors streamline the supervision process of assisting doctoral students to complete their studies in the time allocated to the project.

2. Description of research system

The research system starts off with the supervisor identifying a possible research project for the student, within the specific research field. The student is asked to perform a literature search to find out what information is available within the scope of the proposed project. From this initial literature study, the research focus is refined and a flow diagram of the proposed project is set up by the student assisted by the supervisor.

This flow diagram describes the entire project from the problem statement to the proposed methodology, including experimental work that will be performed. Figure 3 is an example of a student's flow diagram in the field of engineering.

At this stage it is important to consider what equipment will be required to perform the experimental work, whether or not the equipment is available, and what the costs involved would be, should it need to be acquired. Also to be kept in mind is what materials and consumables will be required to perform the experimental work, and what funds are available for this part of the project. Another important consideration is ethical clearance should questionnaires, for example, be handed out for completion.

The flow diagram serves as the backbone of the research protocol, which is written next. The experimental work can also be broken down, with a second flow diagram showing more detail.

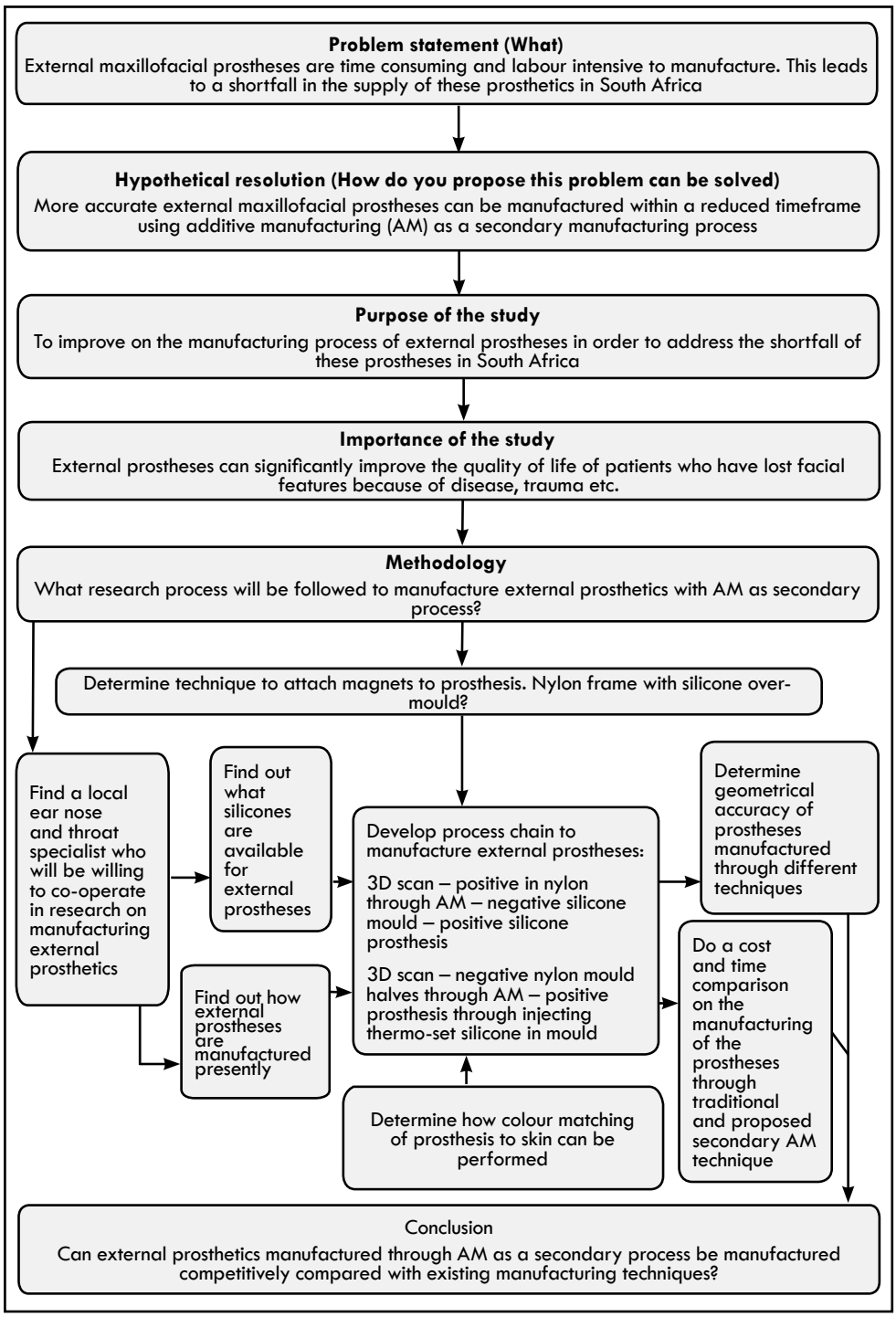

Figure 3: Student's flow diagram

Next, a detailed time line for the experimental work to be performed over the time allowed for the doctoral study needs to be set up, keeping in mind that the last six months will be required for summative assessment. An example of an experimental work time line is shown in the form of a bar graph in Figure 4.

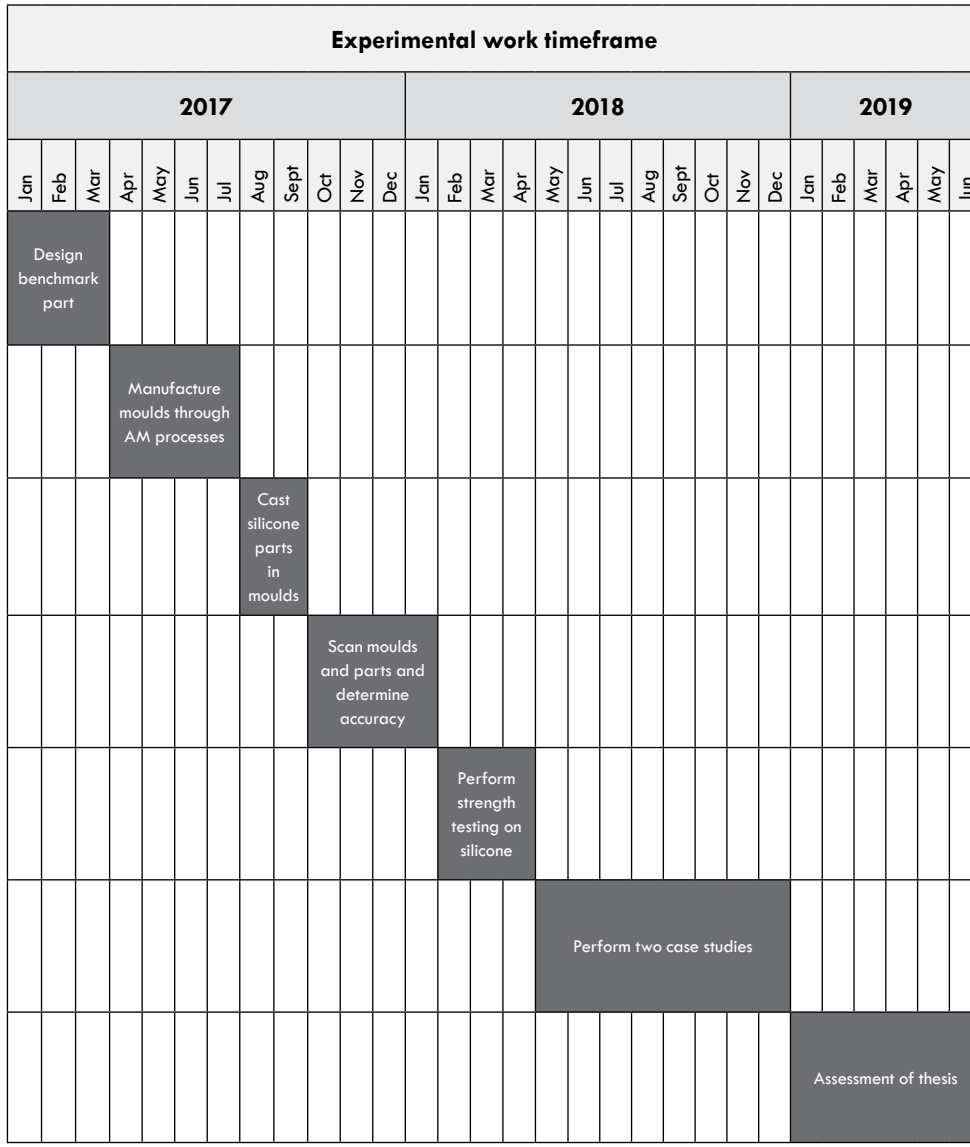

Figure 4: Experimental work timeframe

The next step is to set up a possible chapter layout of the study.

Table 4: Chapter layout

Chapter 1 Overview of dissertation
• Introduction
• Problem statement
• Hypothetical resolution
• Importance of the study
• Methodology
• Flow diagram of study
Chapter 2 Literature review
• Introduction on the history of external maxillofacial prostheses.
• How were prostheses manufactured traditionally? Describe all processes in full. Conclude from this that traditional techniques were time-consuming and required skill.
• Describe the current backlog in maxillofacial prostheses.
Chapter 3 Literature review continued: Additive Manufacturing (AM) for maxillofacial prostheses
• Mention that AM has been used to manufacture external maxillofacial prostheses.
• Describe basic principal of AM; layer-by-layer process.
• Different AM materials: powder, liquid.
• Means of binding material in AM; laser, printing.
• List all AM processes; state that in this study you will only focus on laser sintering, SLA and Polyjet.
• Describe laser sintering, SLA and Polyjet processes in full.
• Describe techniques for determining geometry of maxillofacial area; CT, MRI, laser scan.

- Describe how conversion from CT, MRI and laser scan to AM file format works.
- Describe existing methods of manufacturing external maxillofacial prostheses through AM in full. This is the focus of the study and should make up the largest part of the literature study.
- Conclude that a proper study has not previously been done on comparing prostheses manufactured through traditional and AM in terms of cost and time as well as accuracy of prostheses.

Chapter 4 Experimental procedure

- Design a benchmark part to determine geometrical accuracy of prosthesis manufactured through AM.
- Manufacture the positive benchmark part through different AM processes.
- Manufacture negative moulds of benchmark part in nylon through LS and resin through SLA and Polyjet process.
- Cast benchmark part in silicone moulds.
- Compare accuracy of additive manufactured benchmark part to CAD.
- Scan silicone benchmark part and compare accuracy to additive manufactured benchmark part.
- Additive manufacture moulds to cast test pieces in silicone for tensile and tear resistance testing.
- Perform tensile and tear resistance testing.

Chapter 5 Case studies

- Perform two case studies comparing the manufacturing of actual prostheses using the traditional and additive manufacturing techniques.
- Compare cost and time in manufacturing the prostheses through the different techniques.

Chapter 6 Results

- Describe the results from all experimental work.

Chapter 7 Conclusion

A time line is also set up for writing up the thesis (Figure 5). It should be noted that there will always be an overlap in these activities, which means that while one activity is brought to a conclusion another aspect of the project may emerge. This should correspond with the experimental time line so that results for experimental work can, for example, be written up after the experiments have been performed. The purpose of setting up a timeline is to force the student to start writing up his/her thesis from day one and not to leave it for last. Students often underestimate the time required to write a thesis.

The initial flow chart and time lines can be refined as the research progresses. The important thing is to remain focused on the core of the research project and not to waste time on less important aspects. The advantage of the system described here is that it gives the supervisor and the student a "bird's eye view" of the entire study.

By colouring in the blocks in the flow diagram to indicate what work has been completed, one can easily see how the study is progressing and what still needs to be done.

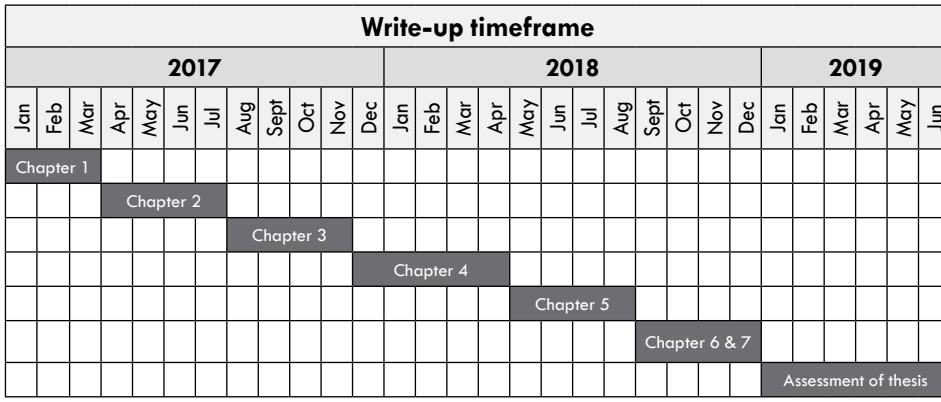

Figure 5: Write-up timeframe

3. Weekly meetings

It is helpful to have weekly meetings with all students who are on campus, and as often as possible with those who are not. At the beginning of the meeting the student shows the supervisor his/her project flow chart where progress is indicated through colouring in the relevant blocks. Also shown are the bar-graphs of experimental and writing-up

timelines. Presenting this is helpful in reminding the supervisor of the student's progress since supervisors often have a number of postgraduate students to keep track of simultaneously. It also serves to remind the student of what still needs to be done and how much time there is left to do it. If a student is running behind on his/her timelines, revised timelines should be presented with the remaining work re-divided into the remaining time.

A written report is kept of each meeting where objectives are set for the next meeting. During the next meeting it is checked whether the objectives for this meeting have been met and whether any possible problems have been experienced. Both the student and the supervisor/supervisors sign on the report to serve as evidence of the meeting (see Table 5).

Table 5: Meeting template

Date of meeting:	
Date of next meeting:	
Were the objectives set for this meeting reached and if not, why not?	
Objectives for next meeting:	

Signature of student	
Name and signature of supervisor/s present at meeting	

4. Semester colloquium

A colloquium should be held at least once per semester where students are expected to present their research to their peers, supervisors, departmental research committee chairperson and the Head of the Department. This helps the students to become accustomed to presenting in front of an audience. Presenting also forces students to think logically about their research because they have to condense their study into only

the important facts since they have only limited time in which to present. The format of presentation is according to the flow diagram which is elaborated upon in a PowerPoint presentation. The bar graphs showing time lines are also presented and any problems relating to experimental and other work are highlighted. A record is kept of progress and problems experienced for each student during their presentations. The colloquium furthermore serves to put pressure on students to make progress with their research.

THEME 4

THE SUPERVISOR AND STUDENT – ROLES AND RESPONSIBILITIES

POSTGRADUATE SUPERVISION

Three dimensions and the three stages of the doctoral research journey

GINA WISKER

1. Overview

This contribution considers three dimensions of research supervision and the three main stages of the supervisor and candidate relationship during the research project. It does so in the hope of enriching our understanding, our management and experience of this complex, potentially fruitful and sometimes rather fraught relationship, which aims at developing a successful researcher, and producing a sound, achieved, well-written research project. The ideas and practices discussed here are both experience- and research-based. The experience is my own as a supervisor, with 30 students completed, 34 examined, and with 'guardian supervisor' experience as part of a large cohort-based PhD which graduated 250 doctors. It also builds on experience as a facilitator of hundreds of workshops and courses for supervisors in the UK, Ireland, Australasia, South Africa, Sweden, Denmark, Norway, Trinidad, Jamaica, Barbados and Malaysia. The discussion is based in research, both my own and that of international others (to date some of it has informed *The Good Supervisor* (2005, 2nd ed., 2012) and a number of articles.

The three dimensions I am considering here are personal, learning and institutional, and the three stages are the beginning, the middle and the end.

2. Introduction

Much work on postgraduate supervision focuses on the beginning of the doctoral student's research journey, and is concerned with the importance of establishing both

good, negotiated working relations between supervisor and candidate, and a sound research project which is likely to succeed (although of course also likely to change) (Lee, 2008, 2011; Denicolo, 2004; Eley & Jennings, 2005). Some researcher authors have concentrated on the examining process which takes place at the end of the candidature (Holbrook et al., 2004; Kiley & Mullins, 2002), and most recently there has been an increased focus on the emotional dimension of supervision, considering personal issues influencing learning and the progress of the research journey, including managing stress (Johanssen, Wisker, Claesson, Strandler & Saalman, 2014; Vekkaila, Pyhältö & Lonka, 2013), hierarchical practices (Manathunga, 2007), and breakdowns and break-ups in supervisor-student relationships (Wisker & Robinson, 2013). In 2003 (in Wisker, Robinson, Trafford, Lilly & Warnes, 2003) I identified three dimensions to supervision: personal, learning and institutional. These inform this theme, as they enable us to focus on a range of interactions and issues. More obvious are the three stages, *beginning, middl*e and *end*, and yet these have emerged more clearly for me during workshop work with supervisors concerned about their varying engagement with doctoral students whose work needs, ultimately, to be conceptually robust, well expressed, and independent, making a sound contribution to knowledge.

The 'beginning' stage is when relationships and projects are first negotiated, time management agreed upon and expectations seemingly also managed. In the middle stage, candidates maintain the momentum, work long and hard, have conceptual threshold crossing (Wisker, Morris, Warnes, Lilly, Robinson & Trafford, 2009; Wisker, Morris, Cheng, Masika, Warnes, Lilly, Trafford & Robinson, 2010), breakthroughs (or not) and develop sound data acquisition, analysis and sound writing habits, returning iteratively to the elements of their work to understand it more deeply while developing coherent, thematic, theorised threads. The final stage is when they finalise the written thesis in whatever shape – several articles and a theorised 'wrap' (the preferred Scandinavian and European model) or a monograph, submit, and then have the work examined with or without a viva/oral examination. The coda to the end is revising after comments (if necessary), on which very little has yet been written, and then publication beyond the thesis.

This chapter looks at the three dimensions and the three stages, and also throughout considers two of the major tensions which have been highlighted as issues for supervisors during supervisory workshops. The first is the balance between time and conceptual quality. This is a balance or tension between the time to timely completion (usually expected and funded as 3-4 years) – and the need for a conceptually complex,

well-written thesis based on a research project that does develop new knowledge and understanding and has conceptual threshold crossing explicit within it. This latter is a non-time bound learning leap, which sometimes is too difficult for students who devote even ten years or more to their research, and is often a little ambitious within the three-year time frame. The second one is the tension in the supervisor-candidate relationship between supervisor's responsibility, guidance, and the independence, the autonomy, of the researcher who, we hope, exits the PhD with the desire and ability to continue to carry out research projects or professional-based research of some sort, and a range of useful high quality postgraduate skills.

3. The first stage – getting started

Research advice books on the first stage of supervision offer several models which can seem to align with the three dimensions, personal, learning and institutional, and which I have offered as a structure to consider in doctoral supervision. Lee's framework (Lee, 2008, 2011) considers the role of supervision to be matched or not by the response and expectations of the candidates and to fall into the categories of functional, enculturation, critical thinking, emancipation, relationship development (Denicolo, Park, Bohrer & Clarke, 2010), and focuses on the 'elusive' concept of 'doctorateness', as do Trafford and Leshem (2009). My own advice-oriented work considers setting up good ground rules, negotiating expectations, and also negotiating an appropriate, do-able research question, project and set of timelines along with negotiated, sufficiently systematic interactions. The establishing of these systems are in the **institutional dimension**, since they support and underpin the developmental research, contribution to knowledge (epistemological development) and personal development (ontological), which will be the main work of the PhD process. Supervisors need to co-establish the systems and regular meeting schedules so that the doctoral student is aware of the regulations and expectations, and is simultaneously supported by the ground rules and the regularity of agreed supervisions and agreed tasks. In terms of the **learning dimension**, doctoral students play an active, equal part in negotiating these, and in co-determining who has responsibility for essential work such as decisions on the research question, the theoretical framework and the methodology and methods, although there are disciplinary differences. For example, in large funded science (or social science) projects, sometimes doctoral students apply for a research job and are given a question to work with; however, supervisors with such projects have also acknowledged that they work together to nuance the question so the student has ownership. Together supervisors and students can agree what training sessions and

essential elements of university postgraduate skills programmes the student should take part in, all of which are also intended to be a support and foundation to their learning, and to their security and development as a person undertaking research. The dimensions of the personal and learning are often intertwined at this stage, as they are throughout the learning journey, with each understood as part of a functional approach to supervision, which can also act as a form of enculturation into the ways that the discipline questions, constructs and interprets knowledge and how research is written in the different disciplines (Lee, 2008, 2011; Wisker, 2012, 2015; Sword, 2012). Any such structural foundation is in alignment with the regulations and expectations of management-oriented versions of the supervisor role. Expectations about the student-supervisor relationship, the ways of undertaking the research learning journey, and the writing also need negotiating and understanding in order to be both personally and intellectually supportive and challenging. What that actually means over time is often an issue – these are not easily understandable, consistent practices, and despite one's best intentions, supervisory exchanges are not really exchanges between equals, as has been pointed out by Manathunga (2007) and Grant (2008). A structurally functional model of support needs to be augmented by a focus on helping the candidate to develop as a researcher and learner, while not losing sight of the **personal dimension**, the student's identity, emotions, ontological experiences and developments.

Supervisors are advised to be professional and friendly, but not over-friendly, since a more formal relationship can enable complex interactions and sometimes quite challenging discussions concerning understanding or lack of it to take place, while a "friend" relationship might make this difficult; being friendly, however, means taking care of the students' settling in, putting them in touch with student and postgraduate support and doctoral college student services, and the research community, both locally and through international networks. This is always important and particularly so if the student is from a different culture or country, since they are also settling in to the climate, geography and culturally inflected behaviours, as well as culturally inflected learning behaviours. Guidance and sensitivity all help this process – putting them in touch with supportive others, both physically and online – to enable these intelligent, enthusiastic researchers to get on with their work and their development with fewer anxieties about their everyday hierarchy of needs (Maslow, 1943), which includes finding a place to live, how to fund their work, and how to make friendships in a new environment of learning.

The learning dimension is important in the early stages. Students are expected to develop their project proposal and to indicate that they can identify and ask research questions, either producing these for themselves or taking ownership of questions which form part of the funded project should they be working in that context. They have to read in an exploratory way, finding their way through the field, identifying both the theories to underpin their work, and the previous and current critical work in that field. It is useful to suggest reading material, to offer articles and books, and also to identify what extra skills or contextual information they might need to learn in order to search selectively and in a focused way online, in a physical library and other holdings, in archives, in locations appropriate to their discipline and research area. In the early stages, the reading is probably broad, establishing the field, and then needs to be undertaken selectively, critically, and focused onto the essential, the fundamental, and the very specific. This means they have a broad sense of the arguments and previous work, and can focus down into understanding and then selecting the theories which will form a theoretical underpinning to their own work, and the more critical work of putting those theories into practice in similar areas, with which they will enter into a dialogue. Discussing and writing about the theories and the critical work with the supervisor and then exploring these theories in early drafts of the literature review element of a project proposal, is a key moment for the development of research. Students need to develop foraging and sifting, selection and analysis skills to find the theories which underpin the work and then enable a lens to be cast on the research. There is a need to develop skills in identifying major themes and significant issues in the literature, which develop, explain and translate those theories from the original complexity to the more accessible, more current work others are doing. They need clarity about the direction and concerns of their own work, and the language of debate in order to enter the learning conversations with the theories and theorists, as well as the more current critical voices that they have used in their own work. This crucial moment enables a theorised conceptual approach, as students begin the experience of writing at doctoral level. Supervisors might find it useful to offer examples of good journal articles in the same discipline and area in which the student is working, as models. Then they can work together to see how these establish a theoretical framework (underpinning and informed theories, the arguments based on these theories, the way in which they enable a focus on the research questions and research in practice); an understanding of the work in the discipline and broad topic area; and the conceptual framework of the work (the ideas, concepts which frame structure and underpin the work).

Understanding how to work with the literature in the field is a developmental stage for students. It often leads initially to descriptive and informational writing, but this is part of an iterative process of continued development of understanding and confidence in expression, guided by discussion, which probes the student's understanding of the reading, shares pointed questions on specific reading, asks about the relationship of theories from the reading to their own work, and prompts thoughts about emerging themes, emerging contrastive arguments, and where their own ideas and arguments and their own work are beginning to fit into the dialogue with this other writing. Careful feedback on early drafts of the literature review can help shape critical thinking, as well as expression which uses argument, and interweaves the selected, appropriately excerpted, interpreted work of others into a dialogue with their own work, using the discourse of the discipline and at doctoral level, and references appropriately, all of which are good writing skills to be taken further throughout the thesis and beyond into publications. Work conducted on the Doctoral Learning Journeys project (Wisker, Morris, Cheng, Masika, Warnes, Lilly, Trafford & Robinson, 2007-10) indicated the close connection between epistemology and ontology in student engagement with the research project. Broadly speaking this suggests that the students' sense of identity, being, the world, their confidence in what they are seeing and learning, is an emotional as well as an intellectual experience for them. It is closely linked to their development of confidence in their thinking, understanding and articulation of the ideas and arguments which underpin their own work, and the structure, theorising and clarification of their own work. It is also linked to their development of confidence as contributors to the contestation of knowledge and its construction in their discipline area and in their specific research focus. Reading and developing written dialogue is the key to this, testing out thoughts through writing, then refining and clarifying them. Some students need highly structured, step-by-step activities; some need ongoing conversations followed by writing; some need to haul in their wide ranging thoughts to develop an argument and a clear thread of understanding. Since they all differ, the role of supervisor, I believe, is to have a developed repertoire of response, a sensitivity to spot when and how to change our ways of engaging and enhancing to match and enable the student's development, which means we balance sensitive support and engagement, with the more challenging questioning and probing and prompting, the structured and the free thinking, all of which help push, pull and enable the learning, and the person.

In response to the question I raised about the tension or balance between development of autonomy and the guidance and responsibility of the supervisor, I believe that

a structured, functionally oriented, agreed, systematic set of supervisor-student interactions can remove the anxiety at some level and so support the more complex, conceptual questioning and knowledge construction which is founded on problematising, challenging and then hard work. Some work with the identifying of postgraduate skills seen as graduate skills useful for their academic and other professional development beyond the PhD is part of this early stage, so as supervisors it is useful to encourage students to identify their skills and needs, realise these needs through a focused conversation and the use perhaps of a skills audit (Wisker, 2005, 2012). We also put them in touch with a regular schedule of skill development modules, and with the research learning community, so that they can test their ideas and developments, places where they are stuck, ways through, with others undertaking research; hear the research of others and so the ways in which they construct questions, explore literature, deal with difficulties and express their early findings, as well as ongoing problems and questions; and have the emotional, psychological and intellectual social support which encourages learning at this level and also makes being a research student enjoyable.

4. Middle stage – momentum, hard work, confusions and contestations, conceptual threshold crossings

In the middle of the work, students are likely to be working in a consistent, intense, focused fashion, gathering data, conducting experiments, continuing to read, dealing with data and learning to carry out robust data analysis. Motivation to undertake a PhD is something we ask about earlier in the process, but maintaining that motivation and the momentum, when the actual research is being undertaken, is often quite difficult. Sometimes results are not forthcoming or field work is not even possible. Experiments 'fall over', and the management of data is tedious. Some students become so lost in the potentially rather boring processes of charting, labelling, coding and analysing that they lose their way. They forget what their question was and, worse still, they cannot see why they were interested in undertaking this research in the first place. This is a slough of despond, a moment at which many students leave their studies, since they seem to be making no progress towards finding anything interesting, and the weight of work is heavy and tedious. At this point, one of the key roles of the supervisor is that of motivator: another is mentor, experienced friend, one who has been through such sloughs in the middle of many pieces of research and knows how hard it is to access some data, find themes and patterns, apply theory to the emerging patterns and start to see something meaningful. At this point, the supervisor can be a key to progress; supervisors can help students to gain access to material it has been difficult to source (or

which is not known to the student but to the supervisor and his/her contacts), supporting them as they make mistakes, have confusing results, meet barriers. Supervisors can help celebrate the successes when students not only discover something but theorise and articulate this discovery. Having a regular supervision process supports ongoing work through the main, middle period of the student's research. Students might seem to go away and get on with the work, but supervisors need to be accessible should they need to discuss what confuses them, the value and meaning of what they have found, ongoing questions and new perspectives. Being supportive, clarifying, reminding of the original questions and teasing out what they might mean, what is involved in exploring them, and indicating the need to maintain perspective and focus are all essential to that momentum of the research and its expression in the writing as it develops. If supervisors maintain a dialogue with students and their work, prompting, questioning and encouraging conceptual work and more complex thinking through feedback and modelling processes, they can enable students to take responsibility and control of their work themselves. Writing is an important part of all stages of the research journey, and in the middle the student needs to develop regular writing habits, and a confident, competent style. At this middle stage, writing *for* them or *over* their writing can be disabling instead of helpful and certainly works against the development of good writing habits of their own. I suggest that it is useful to offer and share models of good writing from other sources, to suggest well-written journal articles to be processed for how these present the literature, the methodology and the data analysis, and for how articles develop and maintain argument and story throughout. Talk about the processes rather than the content and look closely with the student at elements of the developing writing in order to help establish good, confident writing habits. There are several good writing blogs which will help with some of this, such as the doctoral writing SIG, and Pat Thomson's 'patter'. Students for whom English (or whatever nationally recognised language is used) is not their first language will also need information and guidance about where specific language help is available, so that they are not sucked into a website which offers to do their writing for them. Taking advantage of too much 'help' which actually does the work for them can result in their own inability to see what they are finding in their research, to understand it through writing about it, and to see how research writing is developed, worked on, improved. They need to develop these skills of writing well to communicate their work and their arguments, through the PhD and beyond, since they will later on be expected to write for publication, as well as in other forms for their future (or current) profession. Too much help is actually disabling and disadvantageous. Being clear, supportive, offering models and developmental

feedback can nurture and enable the student's development of the skills in their own work, in their own way.

Institutional – The stages of research project approval, any kind of yearly or other staged progress check, and of transfer to PhD are important institutional process moments, some at the start, some the middle and some the end of the research journey. At each of these institutional gate-keeping moments, the student needs our highly focused supervisory support. The first of such stages is in writing a realisable, well-crafted proposal; the next staged moments show that they have developed their ideas into research practices and are aware of, own and can articulate what they are discovering, and what it means, what it might contribute. Then at the transfer stage they produce a mini version of the thesis so far, in alignment with the university requirements, ensuring that the conceptual and theorised elements of the underpinning and informing of the work are clear, well thought through, owned and understood, and well expressed. They defend their work in an oral assessment at this stage, or in a presentation to others, and show that they understand it, initially to us, the supervisors and the first listeners and readers after themselves. Staged support is important, without taking the work over. At these stages students are gaining more independence but they also need to have developed and to evidence ownership of their research, conceptual work, new understanding and a sense of their contribution to meaning, as well as clarity of arguments and expression. They need to be able to explore and discuss with confidence. Discussions and presentation opportunities before any of these stages will help students in this complex evidencing of their mixed development to date of both the project and research skills. If any staged assessment, including and in particular, transfer, is not a success, then as supervisors we have more work to do with the student on whichever issues have emerged. We might well be working with them to further develop a robust, theory-based, conceptual level of work – which is critical and creative enough, and which really engages with the concepts, the issues and the questions, and can identify what the contribution to meaning (as knowledge) is, as well as the contribution to information (as knowledge). We might also (instead) be working with students on the development of a confident, well backed-up voice throughout their work, including a use of the appropriate discourse, claims backed by evidence, evidence linked to claims, and the 'red thread' of argument running through the whole. Before any such staged event, it is useful to share models of successful work from others, discussing the successful elements, and reflecting with the student on their own work to date. It is also useful to rehearse (but not over-rehearse, so the responses become mechanical) so that the student has a chance to consider their responses to

possible questions related to the research and its achievement to date, and the plans for further work. Such focused and reflective, developmental work both before and after a staged event, particularly a transfer, can all help the student to see the shape of their work, get it in perspective, realise what they have achieved and what is still to be done, and to plan ahead. In research conducted with doctoral students (Wisker *et al.*, 2010) one student identified the rehearsal with the supervisor and the presentation of work for a staged event as really giving him a sense of the direction of the work, and the patterns of ideas, arguments and findings emerging from it. He said 'I can see shapes'. Enlisting the support of other research students a little further on in the research journey, to help question, nudge, promote and offer models is sometimes more help than doing this ourselves, as those other students are closer to the learning progress of our own students, more accessible perhaps to talk with.

5. Potential issues and problems that can arise

Many problems can arise over time, in the process of working with students. Some of these relate to the progress of the research, some to the conceptualisation of it, interpretation, theorising, some to the writing, the communicating of what is being found and why it matters (learning dimension issues), and some to the relationship between the supervisor and the student (personal dimension issues). Sometimes problems with the student-supervisor relationship are caused by lack of progress of the project. In some instances, blockage in the conceptual work and contribution to knowledge seem to a student who is stuck or frustrated to be the fault of the supervisor. In such moments, a student might need someone else to blame for his/her lack of progress, and the supervisor is the first choice. For some students, however, the supervisor is actually not providing enough guidance, and 'enough' guidance seems to vary between students in terms of their needs. Since there is a variation in the amount of guidance needed, it is a good idea to establish and maintain regular meetings and turnaround of writing, and to indicate your accessibility for extra problems; it also helps to encourage students to seek help from other students, from books, courses and the networks of other researchers to which you might well have introduced them. Some supervisors have a hands-off approach for good or ill and sometimes with the best intentions seeing students rarely, but for students who are stuck and confused, or who need the structure of regular meetings and some close attention to their production and its quality in order to do some fine tuning, the hands-off approach is perceived as neglect or, as Gurr puts it 'benign neglect' (Gurr, 2001). Other supervisors unfortunately are too busy, or unaware that the student is struggling in the middle period. The student might

be struggling with boredom and lack of motivation; but he/she could also be struggling with sudden breakthroughs in theories or conceptual understanding. Ground rules and regular meetings help both issues. Nudging and nurturing some latent and emerging breakthroughs in ideas and findings requires a mixture of close attention balanced with freedom and independence. Careful feedback on written drafts, however short, can demystify the process and help nudge and clarify the thinking processes. It is helpful to share with students that blockages in thinking, in structuring and in really fully understanding how the work is taking shape, what is being found, how you can articulate it, are a normal part of the process. Working together to find ways of pushing beyond blockages of the amount of work, and through to the interpretation of that work – i.e. support work for breakthroughs in thinking, or conceptual threshold crossings – are crucial in the middle stage (or at any stage when they emerge) of the research project. Conceptual threshold crossings are moments in the doctoral learning journey where the originality and contribution of the work are more clearly understood and expressed, moments which indicate conceptual, creative and critical work at a level suitable for a doctorate (Kiley and Wisker, 2009; Wisker *et al*., 2010). This more clear-sighted, insightful, clear thinking can be nudged by questioning, nudging, feedback, face to face, with or without the text, or prompting on the page, asking, what is this?, why?, how can you be sure?, what backs this up?, what can you see?, why should it matter?, questions which move the student on from decisions about informing and categorising into a more conceptual level of work and can also develop the skills of clear communicative writing.

Personal dimension – The literature suggests that emotional and wellbeing issues can arise at any time, but particularly in the middle of the student's research journey. Some students and supervisors break down in their relationship, some permanently, and students leave and seek another supervisor, or supervisors stop working fruitfully with students. The emotional fallout of breakdown is great and the project usually suffers, as does the student (and often the supervisor too). Some problems are the result of supervisors retiring or having to transfer to another job and not being able to take the student's supervision with them. Work we have conducted focusing on supervisor/student breakdowns suggests that breakdowns cause stress and distress to both students and supervisors. Johanssen *et al* (2014) look at moments when students and supervisors fail to think in harmony and the stress leads to depression and a desire to end the relationship and the projects. Our work with 'doctoral orphans' (Wisker and Robinson, 2013) indicates that while some such relationships can be mended through using structured ways forward, revisiting ground rules, setting targets and so on,

some relationships remain fractured. If it is necessary for the supervisory relationship to cease, then, if there is a supervisory team, it may be acceptable for the main supervisor to step back and another to take the role. If there is a central administrative structure, then the doctoral college or similar could allocate another supervisor with similar interests, who is willing to take on the supervision role for a student who is already part of the way through their work. Many such relationships work well when they begin with a willingness to revisit and audit the work, establish new ground rules and working relationships, and move forward with completion in mind. Not unnaturally, students might well feel that they are exhausted at the thought of almost beginning again in response to the expectations of the new supervisor, and the new supervisor could feel worried about undoing work already completed, about the documentation, and about revising supervisor arrangements and establishing new robust working relationships and timelines which will enable the student to complete a conceptually sound piece of work in the remaining time. Our research (Wisker & Robinson, 2013) indicates that for some, the changes are very disruptive, while for others, where these new arrangements are understood and agreed by both parties, the work can proceed well, and the student who survives and re-focuses has a fuller understanding and ownership, perhaps because of his/her new, hard-won clarity.

Learning dimension – Conceptual and critical problems can arise at any point in the research: in the identification of a robust enough hypothesis or research question to address, in engaging with literature and the development of methodology and methods, and then again in the data analysis, interpretation and findings parts, and finally in the drawing together of understanding of the whole project and its importance, its findings, its contribution to knowledge. On the positive side, these moments can be seen as moments of threshold crossing. If they are demystified by the supervisor and the research community, and students are able to see models of the work in the practice of others who make such breakthroughs, and so build their own work on similar strategies and trajectories; the breakthroughs then take place even after initial blockages. At the stage of the literature review, a familiar problem is that the work may be overly attentive to detail and to description, listing and detailing every bit of literature that could form a background to the work. Students should be advised to identify the major thinkers and the major contributors to the arguments in the field in which they are working, identifying themes and the debates which are ongoing and which relate to their own interests, rather than a grand coverage of everything, hoping that the main themes might emerge somewhere.

Reading carefully and identifying the themes, arguments and patterns is a good first step, then establishing the fields and laying out the major issues and themes, and finally developing an argument through the voices of the major contributors, as they relate to their own work.

The final stage of the work also brings together all three dimensions of **personal, learning and institutional**. At this point we probably revert to quite intensive and regular supervisions, should we have lost some of that regularity during the middle part of the student's work, while he/she carried out experiments, field work, reading, and writing.

By now, ideally, the student will not be over-reliant on us, since he/she will have developed some confidence in his/her own research and expression. It is important that he/she knows exactly what the rules are about submission, examination, oral or viva, and then also what happens should he/she not pass with flying colours, and have modifications to make to their essays and wrap, or their monograph. Many students still do not realise that modifications are a norm – to some this will mean re-opening the work and taking up to a year to revise, while other modifications are at the level of re-writing and re-exploring only some short sections, others at the level of typos, and some just cosmetic elements. Most students have something to do to the thesis following the examination. Preparing them for this as normal reduces some of the shock and terror and some of the false confidence, the treating of the examination as a bit of a lottery. The one thing that is predictable about it is that the work will be read carefully and some adjustments will be suggested – just as with a journal article after the PhD (or as part of it) – and these adjustments aim to improve the work rather than destroy it. Sound intellectual work and writing, ownership and confidence in the writing and oral defence are all essentials. Defensiveness is disempowering. Take students through those theses that have passed, so that they can identify the consistency of an owned, well-articulated, evidenced and well referenced argument; so that they can see the balance in a good piece of work between the literature, the explanation, the methodology, methods and ethics, the explanation of the data analysis and the development of the argument and theories, resulting from the interpretation of findings; the roles of the abstract and conclusions in stepping back from the work and identifying why it was done, why it was done that way, what it contributes to knowledge and why it all matters. All of this often quite functional and even surgical exploration of the text expression is characteristic of an effective thesis – in whatever shape – and can help demystify the process. Such exploration also offers good models

for the tone and the articulation of the argument, the amount of data used to develop that argument, the relationship between evidence, referencing other work, theory and argument, looking closely together at elements of a couple of these and enabling the student to go away with a clear remit to gut the work, analyse its effective practices and see how this improvement can be enabling for their own work.

6. Last moments

After the oral or viva, or after the written piece is referred, with work to do, the three dimensions come into play again. Students might be emotionally quite sensitive, and they need a confident, assured and organised response which is sensitive to their feelings, the challenge, and which helps move them on to produce the modifications in a systematic way. But that sensitivity and sympathy should not undermine or underestimate the level of intellectual work and expression needed. Doctoral students need to know about their rights at this point: rights to library access and supervisor time, and the shape and form of what needs to be re-submitted and when, so personal learning and institutional dimensions come into play here.

At every stage in our supervision of the doctoral student we will need to be aware of the three dimensions. One is institutional, supporting the students so that their work meets the quality expectations of the different gatekeeping moments in their research journey, and also using the system in which we need to ensure their mitigating circumstances are taken into account, their conversations with other supervisors and students can support their otherwise quite individualised learning, and that they are themselves aware of the exact expectations, the length, shape and form of a PhD (or forms, given the variety). Another issue is the conceptual dimension, since again at every stage there is our nudging, opening their opportunities to share and develop their work with others, to present, to write drafts and discuss developments, and to see and bring into focus the breakthroughs in learning. This is all important when supporting transformational learning, essential to a PhD. Finally, the personal dimension needs to be taken care of throughout. This involves working with them as individuals who have emotional issues, personal family crises, and sometimes issues with us as supervisors, and who learn to become resilient during the process of doing a PhD. There is a range of literature exploring breakdowns and less focusing on the harmonious interactions in which each learns and grows through the student-supervisor relationship.

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ASSESSMENT CENTRAL TO QUALITY DOCTORAL EDUCATION

HESTA FRIEDRICH-NEL & JOYCE L. MACKINNON

1. Introduction

Think about this scenario. You are in your office after speaking with one of your doctoral students and you start thinking about your encounter. Several questions pop into your head. First, what is doctoral education, and how can you provide effective supervision and mentoring to assist the student in developing a thesis of quality? Second and perhaps equally important, how can you contribute to assisting the student to be a productive member of the academic community? Finally, how do you get the information you need to answer your question and develop your skills? The answers to these questions will be explored in this chapter by looking into doctoral education, scholarship, assessment and the quality underpinning these processes.

Doctoral education commonly begins with formal academic preparation at the doctoral level. Formal graduate degree programmes provide both structured and informal supervision and mentoring. Doctoral education also includes both formative and summative assessment of the postgraduate student's work. In formative assessment, the focus is on the research education process while in summative assessment attention is directed to the quality of the thesis. Although the perceived goal of doctoral education is the production of the thesis, the process of producing graduates who can contribute to the body of knowledge in their respective disciplines and be active members of a scholarly community is equally important. While doctoral education provides a focused immersion in research, the newly emerged graduate also requires mentoring and encouragement to successfully progress through a research career.

2. Doctoral education

As previously noted, the purpose of doctoral education is to develop scholars able to contribute disciplinary knowledge through their scholarship and be active members

of their academic community. Being an active member of an academic community requires a person to publish and to participate in academic activities and scholarly debates, and by doing so, add to the body of knowledge. Drawing on the work of Boyer (1990), scholarship is described as discovery, integration, service, application, and teaching. Scholarship also involves a lifelong commitment to thinking, questioning, and pursuing answers. As such, the research process is associated with discovery, integration and application, while service and teaching are linked to postgraduate supervision.

So, how do we prepare for scholarship? It begins with the doctoral education process. During this process the intellectual, personal and psychological attributes of the student are developed. These attributes include becoming employable, economically independent, a life-long learner, and a critical thinker in addition to attaining necessary research skills (Walker, 2010). In order to meet these goals, the student needs to be exposed to the academic environment and be provided with adequate preparation. The student must gain discipline-specific knowledge to become a lifelong learner. The student has to learn the necessary social skills to be a successful academician, and be able to communicate research results at conferences and other academic meetings. These skills will permit the student to attain the dual goals of degree completion and participation in the academic community.

When considering doctoral education, the term "doctorateness" is sometimes used in the literature (e.g. Trafford & Lesham, 2012). This term encompasses the idea that the focus of the doctoral student should be on a commitment to research and scholarship, and can be demonstrated by the ability of the student to think critically, communicate effectively, and do independent scholarly work as evidenced in the thesis. These competencies are most commonly developed through supervision and mentoring.

Doctoral education take-home points:

- The purpose of doctoral education is to create scholars who can contribute to the knowledge base in their respective disciplines and become active members of the academic community.
- Doctoral students can contribute to scholarship-producing activities such as writing a thesis, presenting at conferences, and publishing articles in professional journals.

3. Supervision

Supervision is the central method by which students are inducted into the role of the academy (Green, 2005). In the traditional supervision model, also referred to as the apprenticeship model, a student is supervised by one or more supervisors. However, several additional supervision models have more recently been described (i.e. group, mixed). One of the reasons why additional models are now being used is that different types of doctoral degrees are available, i.e. research-based and the professional doctorates. This has necessitated a change in the way in which students are supervised. Another reason is that supervisors are becoming more innovative in response to the desire to accommodate larger numbers of students.

Supervision is provided primarily by the supervisor. During this process, the supervisor has to fulfil several roles, such as role model, cheer leader, critical reader, mentor and motivator. The supervisor must motivate the student to complete the thesis and in the process should ensure student ownership of the work. The role of the supervisor remains essential in producing a thesis of quality and preparing the student to successfully participate in the academic community. Supervision can be formal or informal, and both are necessary components to create a successful scholar. While supervision is critical for success in doctoral education, it is equally important in career progression in the academic environment, particularly as the supervisor transitions to the role of mentor.

4. Assessment

Both formative and summative assessments are critical in the production of the thesis and the emerging scholar.

Formative assessment

The purpose of postgraduate formative assessment is to prepare the student not only for the successful completion of the thesis, but in a broader context to prepare the student for professional practice, i.e. practice in an academic environment. Formative assessment must occur in a trusting environment with mutual respect between supervisor and student. The supervisor and the student have equal responsibility for the success of the process and the quality of the thesis. The supervisor should provide motivation and celebrate achievement. Feedback must be continuous and provided constructively. The supervisor should ask critical questions to enhance the student's innovative and critical

thinking abilities. Students should not be told what to do but rather asked how they intend to accomplish the desired goals. Both parties should be held to agreed-upon schedules to include timely feedback and response.

Although doctoral students are expected to be self-disciplined, driven and self-directed, students still need the necessary guidance and support to develop into academic scholars. Examples of ways in which students can demonstrate taking responsibility and ownership within the supervisor-student relationship include keeping records of the conversations and discussions, clarifying misunderstandings, and summarising the main points of the discussion at the conclusion of the meeting. The student can also negotiate what needs to be done for the next session, and then start the new session with a brief reflection on the previous meeting and a suggestion of objectives for the new session.

Summative assessment

Formative assessment is used to prepare the student for the summative assessment of doctoral education, the thesis. Common practice for this assessment is to appoint a panel of external assessors not familiar with the research, to validate the outcomes attained and the final product. While there are variations in the standardised grading criteria for the thesis, a thesis of quality should demonstrate originality and innovation. It should make a significant contribution to the body of knowledge. The question posed should be meaningful and relevant. The literature review should be thorough and reflect the research question. The research design should be appropriate to the research question. The data analysis should be comprehensive and appropriate to the question asked. Discussion should demonstrate the ability of the student to think critically and to use the results to develop the conclusion. The thesis as a whole should be organised and well written and should add to the body of knowledge. The student must demonstrate ownership of the work produced. At many universities, this assessment is either preceded or followed by the viva or defence.

Viva / defence

The oral presentation (viva or defence) of the doctoral thesis is a scholarly event and should be considered as a standard assessment practice. Based on the thesis prepared, the doctoral viva should demonstrate student ownership of the research, command of

research components, ability to effectively communicate results, evidence of critical thinking and the ability of the student to defend and interpret judgments.

The structure of the viva may take many forms, but commonly the student will present a brief overview of the findings, recommendations and limitations of the research. Also relevant is how the research has addressed a gap in the literature, the contribution to new knowledge and how the outcomes were attained. The purpose of the questions asked by the panel during the viva is to clarify uncertainties, to highlight the strengths and to elaborate on specific matters. The doctoral students have the opportunity to show verbally that they are in command of the research topic.

5. Challenges in assessment and supervision

Some of the factors that may impact on the quality of assessment and supervision include the preparedness of supervisors to provide quality supervision and the preparedness of students for the supervision process. Additional challenges, such as the relationship between the student and the supervisor, as well as the environment in which the supervision takes place, also impact on the quality of the process. There should be the acknowledgement that an unequal power relationship may exist. In addition, cultural differences should be recognised and respected. Supervisors also face other challenges such as increasing academic demands, and human and other resources available.

Doctoral supervision and assessment take-home points

- The role of the supervisor(s) is to guide the student in becoming an independent researcher and scholar.
- Students need role models and guidance, as well as the necessary infrastructure, to develop as scholars.
- Attributes necessary for doctoral competency include the ability to think critically, accept constructive criticism, exhibit time management skills, solve problems, and show a commitment to lifelong learning.
- Students need assistance to develop important attributes such as resilience, communication skills, and problem solving ability.
- The supervisor must be mindful of unequal power relationships, beliefs, cultures and traditions of others.
- A positive environment should be created with clear and open communication and collaborative learning within an atmosphere or trust.

- The doctoral education process is as important as the product (scholar and thesis).
- The viva is a scholarly event to demonstrate the professional development of the student.

6. Conclusion

After reading this chapter you should now be able to answer the questions that were posed in the introduction. We have explored the elements of doctoral education. These elements include the importance of quality supervision, the roles of both formative and summative assessment and the recommendation that the viva become a standard assessment practice. While it is accepted that there are challenges in supervision and assessment, the rewards of creating a doctoral scholar are immeasurable.

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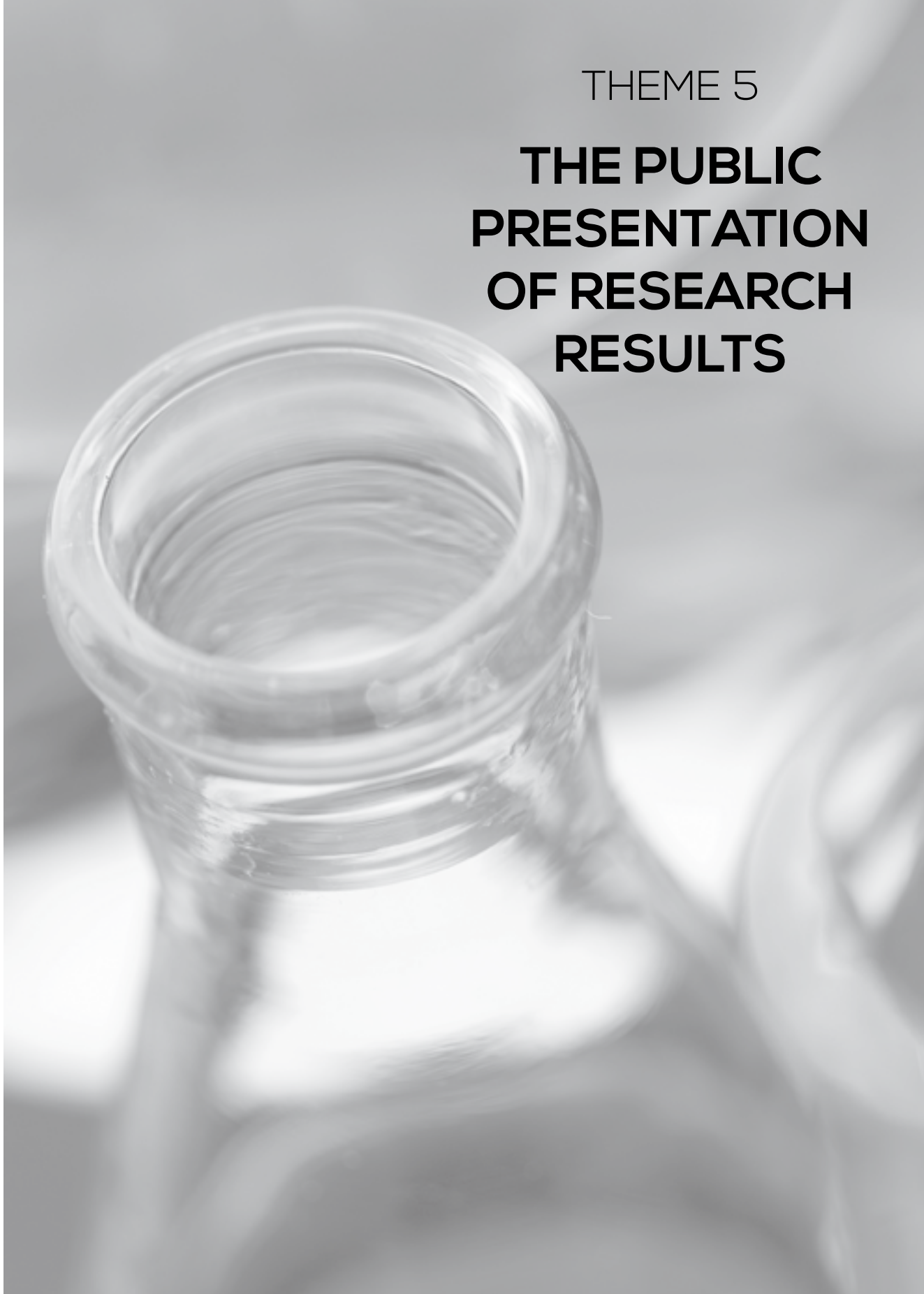

THEME 5

THE PUBLIC PRESENTATION OF RESEARCH RESULTS

FROM CONCEPT TO PAPER

LAETUS O.K. LATEGAN & DESERÉ KOKT

1. Focus

One of the greatest challenges in any doctoral programme is to write up the research, whether it is for the dissertation or for a scientific paper. This chapter will focus on a basic structure than can guide the doctoral student in scientific writing. The example for application will be a scientific paper.

2. Reflecting on common errors when publication is contemplated

Preparing a paper for publication in a science journal is often a daunting prospect and researchers often become discouraged, especially when harsh criticism is received from reviewers. Criticism should however be regarded as a learning opportunity, as the feedback from reviewers is usually valuable and can assist the researcher in developing critical perspectives and arguments. The development of critical perspectives and arguments requires reflection on the part of the researcher, as well as meticulous attention to technical and grammatical issues. Articles that are technically and grammatically well presented, have a better chance of being published.

Four common errors in scientific writing can be identified (see Lategan, 2007). These errors are of:

- a mechanical nature (spelling)
- a scholarly nature (unsubstantiated claims)
- microstructure level (flow of argument and inconsistencies)
- macrostructure level (quality and clarity of purpose).

The following section provides a reflection of common errors that must be considered when publication in a science journal is contemplated.

3. Common errors in publications[4]

Title: The title is not truly representative of the contents of the paper. The purpose of a title is to give the potential reader a very brief synopsis of what the paper is about. Some titles are too long, while others are very short. Ideally speaking, a title should immediately inform the reader of what the research intends to do. The title should therefore receive special consideration to ensure that it relates to the content of the entire paper. Re-formulation of the title is often necessary, especially once the conclusion and recommendation sections of the paper are finalised.

Design: The overall design and layout of the paper require careful attention as well. Not all papers are well planned. They sometimes lack (an) appropriate method(s) section as well as sufficient evidence in support of the research question. It is therefore obvious that the method chosen for writing the paper is not suitable for the kind of research, or the author did not comprehend what the method is all about. When authors opt for a particular method, they should also ensure that they understand what the methodology (knowledge of the method) is all about. A guiding question would be whether the research design is supportive of the kind of research that the researcher is doing? Another supportive question to ask is whether a specific method is known to deliver results in a particular area of research? A third question is simply whether or not this design has been successfully used before?

Research question: Many papers lack a proper research question. The research question can be referred to as the reason why the paper is written. The research question will also provide evidence that the research in this paper is connected to a broader research project. It should be pointed out that, quite often, the research problem is a matter of interest only to the author: it may not be an interesting matter to the scientific community. It could also be that the research problem has already been addressed – perhaps differently phrased or formulated in a more sophisticated manner. Researchers are advised to avoid a situation where a gap in the researcher's knowledge on an issue constitutes the research problem, rather than a gap in the scientific basis. It should also be remembered that some problems are dated or have been over-researched. Some problems will also just extend what we already know or simply multiply the data that already exists. It is important to note that the conclusions

4 These recommendations are an extension of guidelines on the publication of papers drafted for ASSAf (see Lategan, 2011).

should relate to the problem statement and to the title. The alignment between the various components of the paper should be continuously considered.

No argument: Science writing is about furthering a perspective/claim supported by literature and research findings. Many papers create the impression that they are going nowhere: they have endless lists of references and opinions but no argument. On the other hand, some papers have many arguments, but these arguments never constitute a logical conclusion. Any argument should be like a golden thread running through the paper, connecting all of the sections.

Hypothesis: Some papers have no hypothesis at all. Although there are differences of opinion about whether all papers must have a hypothesis, the hypothesis is an indication of what the expected outcomes of the paper could be. The challenge is to use different research techniques to construct a new understanding of a problem and/or to integrate a menu of techniques to present a particular case. The hypothesis should be linked to the research problem. It is also an indication of how in command of the research topic the researcher is.

Method and methodology: Very often the method is not supportive of the research. Essentially, the method may be a good one, though not appropriate to the research. Ample examples also exist where it is evident that authors don't know the difference between research method and research methodology, or how the method should be applied. Knowledge of using a particular method (methodology) is as important as identifying an appropriate method. The research method can be compared to a "tool" that will be used to solve the research problem. Research methodology is the knowledge of how to use the particular tool. Using the wrong tool, or a lack of knowledge of how to use the tool, will not deliver the expected output. Then, the methodology may not be sufficiently explained. The research methodology conveys the method that is used in conducting the research. This can include the methods used to gather data, as well as the tools and instruments used for data gathering. It is imperative that the methodology be clearly articulated and detailed information supplied on the research design and on why a particular research design is selected for the study. The population and sampling technique, the data gathering instrument, data collection procedures and the methods of data analysis also need to be clearly explained. The methodology should, like the literature review, be systematic and the researcher should not make use of assumptions.

Literature review: Too many authors simply repeat what has already been stated in other papers instead of reflecting on and engaging with the existing texts. A major challenge is not to rewrite what has already been stated by others but rather to reflect on the current stance of the research. This means that the literature review must engage with a debate in a particular field of study. Engagement means that various opinions – for or against a case – should be considered in order to construct an informed viewpoint. The purpose of the literature review is to lead an argument on an informed basis. The challenge therefore is not to summarise for the potential reader what the debate is about but to take the debate from where it is to a next level of understanding. The aim of the literature review is to reflect on the latest literature on a particular topic. For this to happen, the most recent debates on a particular topic need to be reflected. It is for this reason important that the most recent sources be consulted. The literature review should present the literature on a particular topic in a systematic and comprehensive way. Discussions should include definitions and explanations on the meaning of the terms and, crucially, they should reflect the contributions of previous research in addressing the problem. Without a critical reflection on previous research it is not possible to establish the so-called 'knowledge gap' which enables the researcher to make a contribution to existing knowledge.

Literature consulted: The latest texts are not the only ones that should be consulted. Identifying the appropriate literature is based on two considerations: firstly, to have a sense of how the arguments have developed over time (historical overview); and secondly, to establish what the current view on a topic is (relevance).

Findings and Conclusions: Papers often have no new knowledge to add to an existing debate. Very often they merely recycle what is already known in research. A good paper will always have something novel in its contents. In the absence of novelty, the horizontal basis of a research topic is simply broadened (we now know more about what we already know!). The approach is rather to focus on a vertical growth of the knowledge basis – that is to extend the knowledge basis. Conclusions should be comprehensive and detailed. Scientific research should be systematic of nature – the literature review and the empirical section adhere to systematic and rigorous presentation requirements, and this needs to be mirrored in the conclusion. The conclusion needs to relate and interpret the findings of the study and the findings should also be brought into line with previous research on the topic. The conclusion should thus be detailed and comprehensive to allow new meaning and interpretation to emerge. It should be kept in mind that the conclusion is where the contribution to

new knowledge lies. The conclusion should speak to and be aligned with the problem statement or research problems, and also with the title. In essence it should answer the research problem or research questions.

Relevance: The relevance and value of the paper is often not well articulated. As stated before, the aim of scientific research is to make a contribution to existing knowledge or to generate new knowledge. It is thus imperative that a science paper convey novel and innovative findings, in essence it should add something 'new' to what has already been found. Some papers are just an add-on to what is already known. A good research paper engages with a contemporary problem (on time) and also provides useful information which is timeless (valued for much longer than just the present). A paper must also provide useful information. So often the paper is of such limited value that no scientific community can really benefit from it. It should also be recorded that papers should be trendy in the sense that they engage with the topical issues in a field of study. In this sense it should also be topical, meaning that it should not be removed from the research agenda.

Clear writing style: It is imperative that a systematic approach be followed at all times, and facts and arguments should be presented in a systematic manner. The flow of ideas should be clear and concise. Assumptions should be avoided and every statement should be motivated and explained.

Referencing: Authors do not always follow the appropriate referencing guidelines. It is important to follow the instructions of a particular journal on referencing. In addition, the referencing requirements and systems of journals, universities and research councils may differ. Authors are therefore advised to update themselves on the required format. References are not always correctly documented. Reference works are an important part of any scientific enquiry and as indicated before, they should preferably be recent and correctly documented, although this will depend to some extent on the type of study. The requirements of the journal in question should also be considered in this regard.

Contents: A paper has different parts (introduction, reason for paper, results, discussion, etc.) and each part has a specific purpose and must not be repeated. The structural approach to a paper is often ignored. Each part of the paper is unique although there is an interrelatedness to other parts, as together the parts form a logical and consistent whole. The different parts of a paper can be compared to the pieces of a puzzle. In

the absence of one part of the paper there can be no complete paper. A complete paper is only possible once all the information is available.

Recommendations: The recommendations may not be applicable or relevant. Recommendations should ideally flow from the conclusions reached in a particular study. The recommendations should be tangible and applicable and also relate to both the conclusions reached as well as to the problem statement or research problems.

Technical requirements: Technical matters may not have been properly attended to. The technical quality of any science paper is crucial, and there should be no grammatical or language errors. There should also be no errors of an even more technical nature such as layout and presentation. It is highly advisable that papers be sent for linguistic and technical revision before they are submitted for review.

Technical requirements: Papers do not always meet the technical requirements of a publishable paper; it sometimes seems as if the "guidelines for authors" have been totally ignored. Typical problems are the length of the paper, the required referencing techniques, the layout of the paper, amongst other things. It is expected of authors that they respect journal requirements because it is the prerogative of the journal to stipulate its own requirements.

Footnotes: Very few authors understand the purpose of footnotes. The purpose of a footnote is to *add* relevant information to the paper that can give a more extended view of the topic.

Language: Papers do not always meet grammar, style and discourse requirements. Especially second language users may experience some challenges in this regard. It is therefore strongly recommended that a paper be language edited before submission. There is nothing more frustrating than having to correct language as one reads through a paper or to have to search for the arguments amongst all the errors.

Scientific writing: Many papers do not have sufficient convincing arguments! Science writing is never about statements – rather, it should always be about arguing a point supported by facts.

Ethical and integrity challenges: Very often no evidence exists that basic ethical requirements have been met. Typical examples of sound ethical practices are the recognition of the funding agency, feedback to sample group, proper referencing, data security, etc. Research integrity is something that cannot be waived. Research integrity also includes aspects such as the quality of the work, the way in which research associates

are recognised and accommodated in the research projects, the way in which data is collected and interpreted and what the motive of the research is. Here I do not even refer to the non-negotiable own work that must be presented. Plagiarism is a no go!

Deliver on promises: Every paper creates an expectation in terms of what it promises to deliver (the solving of the research problem). Sometimes, however, the paper provides no evidence that the research problem has been solved. It is also notable that after reading a paper there is sometimes more confusion than answers. Also, many papers lack coherence, logic or unity. Consider the following example: When one is travelling from one point (A) to the next (B) – there is no logical reason to go from A to C, then back to A, then to D and then only to B. This implies that you have deviated from your original plan. If the argument is that certain difficulties prevented you from travelling from A to B it could mean that you did not plan the route well – a valuable lesson to remember in research.

Writing up: It may be confusing when researchers tell us that they have finished the research and that they have now started to "write up the research." Although we understand the intention of this explanation, one should be careful not to separate the "writing up" of results from the actual research. The writing up and the research are both parts of the same activity. A well written paper is usually planned when the research commences.

Be in command of the research topic: After reading a paper one very often has the impression that the research is still in command of the researcher instead of the other way around. One can also explain this by stating that in a well written paper the researcher is on top of the research and not the research on top of the researcher![5]

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5 The reader may consult Lategan (2008) for some guidelines to evaluate one's research paper.

THEME 6

INNOVATION IN RESEARCH LEARNING

LEARNING FACTORY

A didactic platform for knowledge transfer

ANDRÉ F. VAN DER MERWE

1. Background

Innovative research is worthless if it cannot be used by successors in further research, be commercialised, or serve the needs of society. The innovative researcher therefore requires a guide or a checklist which he can use as a set of goals to align his research to the needs of commercialisation.

The approach of this chapter is to stimulate the creativity of the doctoral student while reminding him or her of the risks and challenges of commercialisation. We consider practical steps to guide the student along the way to understanding and preparing for the process of commercialisation. He/she has to realise that being an innovative researcher and owner of a patent does not necessarily mean the success of the innovation. The student has to understand the importance of following a systematic approach in doing the research as well as in commercialising the research outcome. This research process depends on the maturity of the research value chain. Going from the research problem to the solution to the innovation, product and/or service development and eventually commercialisation, is all part of the research value chain.

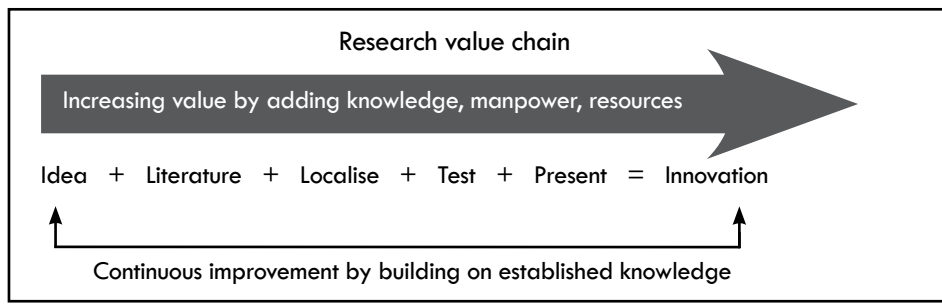

Figure 6: The research value chain

2. The process of commercialisation

When we look at Figure 7 we see the high level "Phases from research to commercialisation". For many new innovations, this is the approximate path of commercialisation; it is true that the example is more applicable to manufacturing a product than to a soft science service, but it is nevertheless relevant to the discussion. The discussions in this chapter refer mainly to Figure 7. This section looks at the phases in commercialisation, and the subsequent sections consider the resources required in the process.

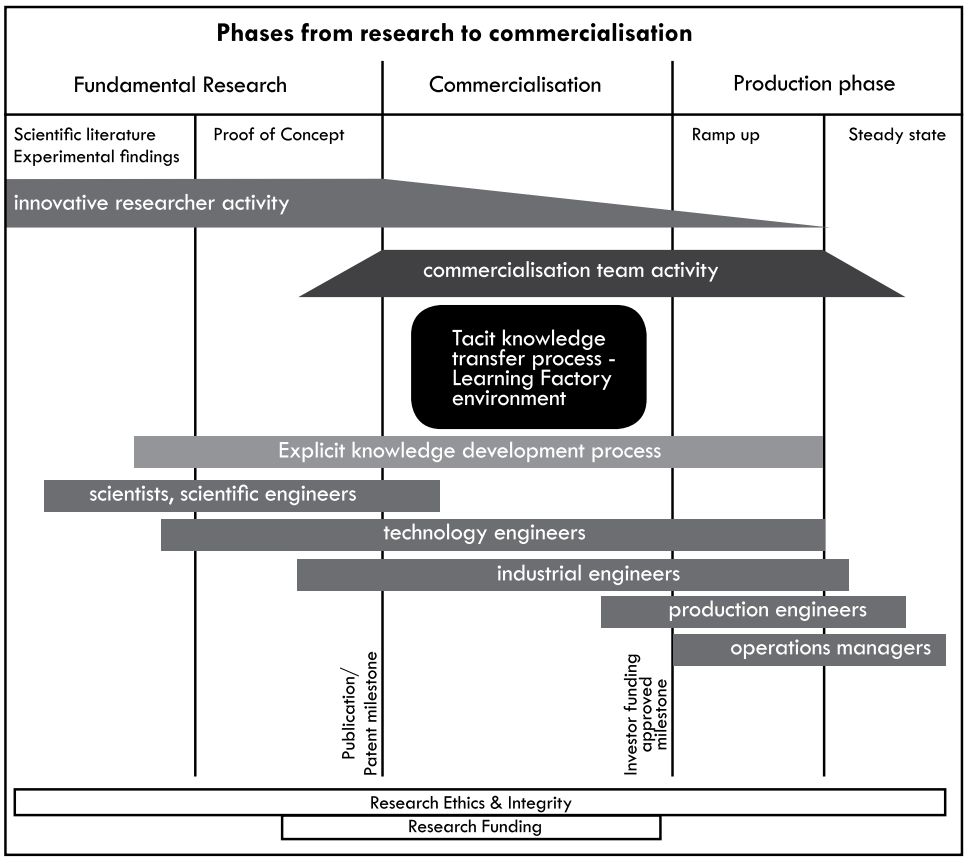

Figure 7: Phases from research to commercialisation

Phases

Phase 1: Fundamental research phase

a) Literature

The literature always comes first. It is the seeking of what others have done, to build a basis for our own research. If you find, after an in-depth search, that there are no others who have considered your topic, or that other researchers have not lingered on the topic, because they have found no basis upon which to progress, it might be advisable to reconsider your topic. There should be some research upon which you can lay a foundation, some previous research upon which you can build. This phase requires thorough attention from the innovative researcher, to find the building blocks, and identify the gaps in the larger body of knowledge. The innovative researcher will then attempt to fill or bridge the gaps through his own research.

b) Experimental findings

Gaps found in the literature need to be filled or bridged. Traditionally a hypothesis had to be scientifically proven to be considered a research contribution. A modern approach is also to consider a research question, and through recognised experimental techniques, answer the research question. One such a technique may be to prove an argument based on a series of expert opinions. This technique is particularly popular with the human and social sciences, but also often used in the natural sciences, engineering and health sciences to move research towards innovative thinking and into the strategic unknown. Experimental findings therefore can bridge gaps in the literature body of knowledge, and serve as building blocks for new innovative research.

c) Proof of concept phase

The proof of concept is a phase rather than a milestone. During this phase several feasible alternatives may be considered. The optimum alternative is unlikely to be obvious at this stage. The best scientific alternative is not necessarily the optimum commercial alternative. The innovative researcher would therefore rather present a range of viable alternatives at this point. Optimisation experts refer to a Pareto front of alternatives. Ideally the innovative researcher would ensure that the range of alternatives is wide rather than narrow, so as not to miss alternatives that may not be so obvious. Concept optimisation should be done through modelling rather than through multiple prototypes, that can exhaust research funding. It is likely that the

commercialisation process would call for design changes in the prototype. If research funding is exhausted at the proof of concept, it is unlikely that commercialisation will succeed, as it often requires refinement towards additional limitations set by the production phase.

Phase 2: Commercialisation phase

This is the phase where a single viable product is multiplied into multiples of commercial value for the seller. A viable product refers to the sum of all value that is added, through activities in the value chain. The value chain is based on systems engineering principles, considering every part of the product life cycle.

The commercialisation phase is the focus of this chapter, and special effort is required from the innovative researcher to align his research output towards commercialisation requirements. Often brilliant research outputs are lost just because funding dries up or the researcher graduates and ventures into remunerated employment. Research outputs aligned with commercialisation inputs (a systems engineering approach) is more likely to succeed into viable business opportunities creating remunerated employment for the innovative researcher and many others.

Alignment starts with understanding the commercialisation input requirements and "buying into" the commercialisation team's efforts. The step by step systems engineering approach requires knowledge transfer, from the researcher to the commercialisation team. Explicit knowledge can be documented, but specific didactic principles should be followed to successfully transfer tacit knowledge. The latter often requires more time and often more patience by the innovative researcher, who may not be an educator, nor have the patience or motivation to transfer his tacit knowledge.

Phase 3: Production phase

The term production should be understood to define any business operation that has matured from the development phase and is productive for the company to add value and generate income. In manufacturing companies it would be goods, in the financial sector it would be client service products, in the tourism industry it could be services, and in the medical industry procedures rendered. We therefore use the term "products" to refer to all value added activities in all sectors. Such products would be considered to have a life cycle. During the first phase of its life cycle, the production phase, value is added to the product. This "value chain" systematically increases the perceived value

of the product until ownership passes to the user, who in turn extracts value from the product. At some future point the product's useful life is ended, often at a cost.

The production phase is not the primary focus of the innovative researcher, and he should rather rely on the commercialisation team and its successor, the production engineers and operation managers, to manage this phase.

3. Milestones

When we do research leading to commercialisation, the following milestones can be identified:

Milestone 1: Publication / Patent

To complete the proof-of-concept phase, the supervisor and doctoral student need to conclude with a publication or patent, which is the first milestone. Some research projects may not conclude with a clear proof-of-concept, which means that the project has most likely not matured adequately to enter the commercialisation phase. The research manager should therefore recognise the absence of a clear proof of concept as a sign of an innovation which is not ready for commercialisation, and further research would be required. An initial proof of concept can be published or patented, and this constitutes the official proof of reaching the milestone. However, a single proof of concept is often not adequate input to the commercialisation phase, as several downstream lifecycle parameters also determine the viability of a product. As mentioned elsewhere, often several proofs of concept are necessary to identify viable options.

Milestone 2: Investor funding secured

The commercialisation phase starts from the proof-of-concept and identifies one or more viable concepts to develop into prototypes. Often the commercialisation funding extends only to the point where an investor is secured, from where the investor "buys" the intellectual property (IP) at a price that could reimburse the research expenses. This point is the second milestone, where the innovative researcher secures major funding to take the commercialised product into the production phase. The innovative researcher (or his organisation) could remain partners in the venture, retain only turnover royalties or sell the IP outright. In all cases the researcher may remain the technical development consultant to the product development team beyond the second milestone.

4. Persons in the research and commercialisation team

The innovative researcher

The innovative researcher is the master's, doctoral or the post-doctoral level researcher who, from a scientific base, combines innovative ideas, knowledge and effort to prove a concept that has not been proven before. He/she uses a fundamental knowledge base from education and from literature to identify shortcomings in the world of knowledge known to mankind. Typically known resource management methods like gap analysis can be gainfully employed here.

Having identified the shortcomings ("gaps") in the body of knowledge, he/she needs to bridge these gaps in order to reliably prove the concept. The researcher would therefore typically initiate a series of experiments to achieve objectives that would bridge the identified gaps. The doctoral student will be the leader in the fundamental research, often supported by a team and mentors, up to the point of proof of concept.

The innovative researcher would partner with a commercialisation team to take the concept into production.

The commercialisation team

The members of the commercialisation team are often not innovators nor researchers. Their function is to help the innovative researcher to commercialise the product. The team's responsibility would typically be to apply systems engineering principles to the concept, and to refine and align the product to the market. They would address the complete life cycle of the product and ensure compliance with all standards and regulations. They would assess risk and develop financial models. Once viable options are identified, they would secure intellectual property rights through patents. Then they would seek investors, and partner with risk-aligned funders. The commercialisation team would consist of experts to address all these responsibilities to ensure a successful production phase.

The innovative researcher would support the team regarding tacit and explicit knowledge transfer throughout the commercialisation phase.

5. The resources

Innovative research refers to new ideas based on existing knowledge. New ideas refer to knowledge not yet documented and yet to be proven. The innovative researcher is the principal in the process of, firstly, finding the gaps in the body of knowledge, and secondly, bridging the gaps. The process of bridging gaps in the unknown often requires empirical research – in common language "trial and error" research. However, the researcher starts from the advantage point of gained knowledge and access to literature, therefore he is deemed to be able to reach the research objectives easier and sooner.

Resources are required to support this process. Gained knowledge is a resource that provides a good starting podium and competitive advantage. However, any successful endeavour into the unknown in order to bridge the gaps in knowledge, will require additional resources. Resources in possibly declining order of importance would then be:

- Knowledge (prior gained knowledge – tacit and explicit)
- Time (to iterate empirically alternative concepts and develop more knowledge for each)
- Research funding
- Facilities and equipment
- Standards

It is likely that most of the research funding will be required for the proof of concept. A selection of several viable concepts have a better chance of surviving the demands of commercialisation. It is not necessarily the concept with the best scientific performance that will be the most robust during commercialisation. The innovative researcher therefore has to apply for funding early in the fundamental research phase, but manage the funding to see the project through several proofs of concept.

It is important to provide funding for documentation of explicit knowledge, and for time to transfer tacit knowledge to successors, without which the research effort could die or be buried in a publication. The importance of this phase should be stated in the funding application.

6. Guidelines

The following can be regarded as important guidelines:

i) Research ethics and integrity

This is the application of accepted norms and the gaining of public trust in the completed research. See Theme 5 for an extensive overview of research ethics and integrity.

ii) Standards and regulations

The consumer seeks assurance that the product conforms to standards and regulations. Branding is used to embed this trust on behalf of the consumer. Through product branding the supplier therefore assures the consumer that the product conforms to the expected standards. This means that the customer does not have to be an expert in the standards and regulations, and that the brand experts do this assurance on behalf of the consumer.

New innovation products are often not branded yet, or have not matured to production phase and are therefore not yet commercially branded. The product could then develop into its own brand, or be grouped into other already known brands.

In order for a product to be branded, it would have to conform to applicable and recognised standards and regulations pertaining to the particular product.

Products for the national market would have to conform to local laws and regulations that in turn would conform to national test standards, such as the South African National Standards (SANS). International markets require conformation to DIN, ISO, EN or similar standards. Such product conformation refers to the technical specifications of the product and relates a product to a specific task performance measureable against the said standards.

Quality standards during the production process are also important in that all products have to be of a similar quality. The ISO 9000 family of standards are therefore used to ensure constant quality. SANS ISO 9000 is an adoption of the ISO 9000 by SANS to make it applicable to South Africa.

Standards and regulations are therefore considered a resource which serves as a knowledge input, setting boundaries to product design specifications, to be considered

during the product development phase. Quality standards, on the other hand, are more related to the production phase where product consistency is required.

iii) Experimental procedures

The innovative researcher should seek relevant, known and community recognised industry test procedures. When the researcher uses published experimental procedures, his/her work can be compared to work by others. He/she can calibrate his/her work to that of others, and then report the improvements.

Furthermore, the researcher can improve on experimental procedures if newer knowledge or equipment has become available, and thus contribute to the world of knowledge.

Experimental procedures are the predecessors of the Standards and Regulations noted above. In experimentation, the researcher should first attempt to use national and international standards, before using other published experimental procedures.

7. Infrastructure and services

The innovative researcher often depends on organisational infrastructure to carry out experimental work. This could differ amongst disciplines: the social sciences may not require complex equipment, while engineering, on the other hand, would certainly require such equipment. Where research relies on experimental procedures using specialised equipment, such equipment must be made available before the research commences. The innovative researcher has a duty to approach the owner and the operator of such equipment to arrange its availability. It is important to plan for a pre-experimentation phase, to understand the output parameter of the equipment, given the input parameters. Often the format of input requires preparation of samples and the outputs require post-processing. The pre-experimental phase would point out possible oversights in the experimental procedure.

Equipment use services which, if they are not available or are interrupted, could delay research work. Electricity supply interruption could cause whole experimental runs to fail, and equipment also often has a start-up phase after a power failure. Experimental procedures depending on steady-state measuring equipment will be adversely affected. Shorter experimental runs and continuous power back-up systems could reduce this risk.

Research is less and less funded by government, and the innovative researcher must realise that resources (including infrastructure usage time) cost money. Often smaller tests are absorbed by the owner of equipment, but when project funding is pre-arranged, larger and statistically more significant experiments can be carried out.

8. Resource ownership

New knowledge, whether tacit or explicit, that has been developed (not found), has ownership. Such ownership belongs to the innovative researcher and the organisation who is sponsoring the research. Sponsorship of research means the making available of resources that can be transferred into new-knowledge resources. The organisation would make available infrastructure, prior knowledge, literature, machines, laboratory workers, and time remuneration of the researcher that the innovative researcher would convert into new knowledge. The ownership of all the resources (including the new knowledge) then remains with the organisation.

However, should more than one organisation be in partnership, all sponsoring the research, then all partners have a right to the new knowledge. Best practice is to enter into prior agreement amongst the partners, on how to share the profit potential of the new knowledge.

9. Mechanisms employed

a) Tacit knowledge transfer

Learning factory – a reiterative learning process

Is the missing link in the tacit knowledge transfer process indeed the *learning factory*? Internationally, universities and corporates create "learning factories" where employees are taught their trade in a hands-on fashion. This is not such a modern idea – throughout the ages fathers have taught their sons their trades of craftsmanship. What is so novel about a "learning factory"?

The international consortium for learning factories has been addressing this issue for the last six years. They define a learning factory as a pseudo-workplace where real factory conditions are created in a mock-up environment. To date the term "learning factory" has not been defined on Wikipedia. The CIRP (International Academy for Production Engineering) special working group on learning factories concluded their

description of the functions and boundaries of a learning factory in Cape Town, during August 2015.

A learning factory by principle uses modern didactic techniques to iteratively transfer tacit (how to) knowledge to the learner. Teachers do not necessarily lecture to students, but rather take on the role of educators, designing and developing learning tutorials that the learners work through. Learners are required to study textbooks with explicit knowledge, and then to come prepared to the hands-on tutorial session in the learning factory. Educators do not show the way, but may be consulted during the tutorial. Group work is allowed, promoting peer interaction, which is essential for career readiness.

Learners are then exposed to the process of tacit knowledge transfer at the hand of explicit knowledge, and these in combination complete the learning process.

Simple concepts are the initial focus of the learning factory, where known methodologies and techniques are recreated and learners follow predetermined paths of thinking to find the improvement towards the solution. Complex problem solving would be done in an advanced stage, depending on the underlying knowledge previously imbedded in the learners.

Didactics in the learning factories

Before we focus on the detail of learning factory didactics, let us position the learning factory in the larger learning process. The learning factory is the bridge between traditional education and independent research. It has become a tool for the transfer of tacit knowledge. The tool relies on the didactic principle of repetition by iteratively doing the same task until it has been mastered completely.

Perhaps a picture would assist in explaining this concept. In Figure 8, it is clear that the student's learning develops from left to right across the spectrum of learning. On the left is the traditional education where the student sits in class and listens to a lecture by the teacher. On the right end of the spectrum, the student does independent research, academic or company specific. In the centre is the learning factory "bridge" allowing tacit knowledge to transfer from the education system to research, and from research back to the education system.

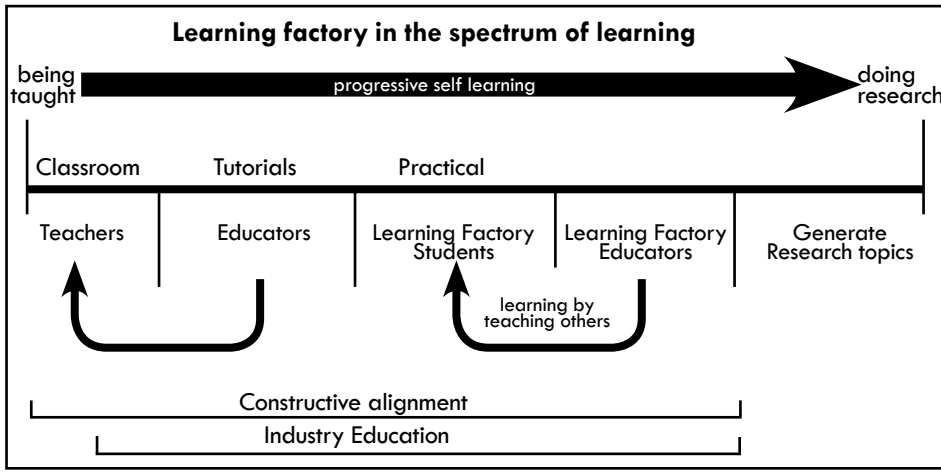

Figure 8: The learning factory in the spectrum of learning

With only traditional education, the student learns parrot fashion, only able to reproduce what has been learned. Innovation is not possible with parrot fashion learning. Innovation is only possible when the student has matured to the point of doing independent research. The education system therefore attempts to mature the learner from left to right in the spectrum. When the student has reached to point of independent research, the tacit knowledge gained can be transferred back to the next group of learners.

So we start on the left, in the classroom, teaching in the traditional way. Then we move slightly right to use tutorials, where the student works through some theoretical examples and case studies, supported by peer interaction. When the theory and some examples have been worked through, the next step is practical exposure.

In the real world, practical exposure involves exposure to many variables, often all changing at the same time. Think of scuba-diving the last minutes before you have to drop off the boat into the water – from where you are on your own – and all parameters have to be considered – and pre-checked. Now consider a night dive at Umkomaas into the Cathedral to see the ragged-tooth sharks hibernating. Do sharks hibernate? The stimuli and arousal level is at an unknown level. The brain is thrown in at the deep end, trying to recall all the theory learned in the classroom.

The same concept is applied in the learning factory, where each learner has to play his part, to form a supply chain of information or in some cases, a real production value

chain, making real life products. The learners are exposed if they are not up to date with the work, but the environment is friendly enough, with peer support, to still achieve the team's goals. All activities are done in the form of group work where not only the actual task is learned, but also soft skills on how to work as a team.

In the learning factory, the real world situation is simulated/mimicked/role-played/ pretended. However, the environment has to involve a certain level of risk. For example, if the learning outcome requires that electrical circuits be understood, then incorrect wiring must result in an explosion, though controlled of course. In short, errors must have consequences. That is how we learn. Our new generation students grow up with an UNDO button somewhere on the screen, which is often helpful, but not always realistic in life. In learning, we want to keep all of the many variables constant except for one (or perhaps two), and then to find out what the effect of changing that variable will be. Some variables have little effect on the outcome; others, however, may have a major effect. This we define as leverage i.e. small effect means small leverage. The UNDO button in the learning factory allows the learners to try out different scenarios, to ascertain the effect and sensitivity of the system, and thus to gain first hand tacit knowledge of what works and what does not.

Getting back to Figure 8, in the centre of the learning spectrum is the learning factory. It is at this stage (Learning factory: students) that the students find their feet and begin to understand how things work. Their immediate goal is to learn to understand and to progress. Progress takes place much as it does in computer games – one moves to the next level. This game theory is directly comparable with the didactic principle of the pyramid of repetition. Each gamer has the desire to complete one level so he can be allowed onto the next level.

Look at the figure again. The progress from left to right is all on the same learning level. The student therefore wants to progress through the learning, through the learning factory, in order to reach the goal on the right which is independent research. Watch children playing a computer game: they make a thorough study (research) of their own mistakes on a particular level if they are not allowed onto the next level. Certainly they have to redo the level, while using up another 'life', but their drive to success is really intense.

So each level of learning progresses from teaching through to independent research. The modern student seeks to achieve success on one level of learning in order to be allowed to progress to the next level (of learning).

In Figure 3 there are two further aspects: one is constructive alignment and the other industry education. Constructive alignment is the known didactic principle of creating a thread through the learning process. Remember the point about changing only one parameter at a time, and therefore studying only one aspect at a time: the student completes a tutorial example, and then tests the variable in a simulated real world situation, in the learning factory.

So what about the learning factory in terms of the educator and research? How does this work? In fact, it is very simple. At the Learning Factory: Educator phase, the student has mastered the knowledge and now takes on the educator role to teach the others. The research outcome is met when the 'educator' has mastered the knowledge to the extent where he can suggest improvements (to the satisfaction of his peers/examiners). Truly this is what we seek in PhD studies: the student who has mastered the work, and has suggested an improvement, which others can learn from and build on for further knowledge – the next level in the game.

"We little researchers stand on the shoulders of giants"

This is the process of "continuous improvement" – which jargon often makes good money for many management consultants. The second aspect mentioned above is *industry education*. Continuous improvement is the action of learning from one's experience (a more positive word for *mistakes*) to better add value through your business processes.

However, just as for our learning level game above, which is ideally closely followed by academics, industry works in levels of continuous improvement. Take, for example, different versions of software. My Apple iPhone constantly requires firmware upgrades which have to be downloaded from the internet. Why? For the continuous improvement of the product. Software developers use BETA versions, because they test the new version before they certify the improved version as a "stable version".

This step by step approach to continuous improvement is exactly in line with the level by level approach to learning.

The academic and industry worlds are thus similar. We start with a new idea (an innovation), learn as much as we can about anything related to it (literature study), analyse the possible impact (tutorial), test it by changing one parameter at a time (modelling and experimental work), and suggest improvements. If the improvements are feasible they may be accepted, and certification issued to move to the next level – to start the process again. Continuous improvement is knowledge improvement, both in industry and at university.

Our teaching and tutorial processes are well versed and many papers have been written on these topics. Many practical technical and vocational education and training (TVET) colleges and universities of technology also succeed in teaching practical applications in real laboratory environments. Often these environments are a good representation of the real industry world. Our next didactic challenge is to allow the student to progress further to the right of our learning spectrum, towards the "educator" and the "researcher". The student is motivated to progress to the next level. Therefore all we have to do is to define the learning outcome for the progression stage called "research". Of course the learning outcome has to be assessed, but only to the extent that the student can recommend an improvement to the level of knowledge.

In our learning (and teaching) environment we therefore have to define levels of learning, with learning outcomes. We also have to facilitate the learning, not only in the classroom and the tutorial room, but also in the learning factory where the student will have the chance to be the student and then the educator. The learning factory has to be created, built in such a way as to facilitate the process of being a student and then an educator. The learning factory will then become the platform for new ideas (innovation), which form the basis of learning at the next level. The learning levels for the learning factory are therefore not always defined beforehand, but evolve as previous levels are completed (and certified).

9. Explicit knowledge base development

Explicit knowledge is available to all people. This knowledge is often in the form of data relating to system parameters. Parameters may be input or output parameters, transfer or performance parameters. They normally reflect how the system reacts to set input parameters. Output parameters can therefore be modelled/predicted given certain input parameters – according to a system transfer function. In a way we can now consider a control system with inputs, transfer functions, outputs and feedback control in a pseudo-analytical system.

Explicit knowledge of such a pseudo-analytical system can therefore be regarded as fixed characteristics of that particular system. However, over time things do change. Mechanical systems may wear out, electrical/hydraulic systems may rust, and external influences may have an effect on system transfer functions.

Input parameters may also vary stochastically, resulting in stochastic variation of the system output parameters. If the system transfer function results in insignificant

output variation, then there is little cause for alarm. However, if the output fluctuates significantly with stochastic input variation, then the system could have accuracy problems resulting in low product quality. Significant system variation implies that an expected output parameter has a high risk of being unacceptable to the customer.

Ideally, product/system parameters variation should be within known tolerances, with a known confidence level. Any products produced by the system with parameters outside these tolerances could be considered scrap and therefore financial loss to the value chain.

Explicit knowledge of a specific system and its sub-systems should be stored in a knowledge base where it can be retrieved by those who need to interact with the data. The knowledge base would typically be designed for quick retrieval. This means that data processing would be done on input- and output parameters alike and transfer functions stored. Stochastic and cyclic variations of input data are stored. Predictions of output parameters can be made. In order for these predictions to be accurate, the input data and transfer functions should be updated regularly.

A process of updating the system's explicit knowledge database should be followed. Higher risk parameters (parameters with larger influence of the product life-cycle viability) should be updated more regularly, and lower risk parameters less frequently. The process of updating parameters would include calibration of measurement systems, continuous monitoring of outsourced components, and continuously managing customer quality feedback. In short, a continuous improvement process should be followed irrespective of the product or service rendered.

Successful continuous quality processes rely on high quality data – explicit knowledge – captured, processed (including calibration) and made available as input to decision makers. Data complexity should be limited to the level and extent of the decision to be made from the data. The same applies to explicit knowledge.

The innovative researcher would develop the explicit knowledge base during the process of tacit knowledge transfer. For example: take an operator through the process of learning tacit knowledge by means of the tutorial system, and then let him identify the explicit knowledge required for successfully mastering the tutorial content. Record the required explicit knowledge, and package it together with the tacit learning module. This tutorial technique would then be repeated for all known procedures in the system. Multiple repetitions of the same procedures could also refine the accuracy of data in the explicit knowledge base.

However, to enhance higher level and analytical skills to solve complex, not-obvious systems problems, one would follow a different approach. In such an approach, all data would be available, and the learner would, for example, seek patterns in cause-and-effect diagrams. These diagrams are simple but powerful in finding relationships amongst data. Another powerful technique is fuzzy logic analysis. The innovative researcher should document all findings pertaining to the system and its sub-systems. Initially a system linear approach can be followed, but all transfer functions should be checked for linearity and significance, and all statistical analyses should be documented, for every proof-of-concept.

10. Quality assurance

Both absolute and relative quality assurance have to be conformed to throughout the concept development and commercialisation process. Absolute quality refers to the technical quality standards to which a product must conform. This could include safety regulations, electrical specifications, integration standards and other standards related to the product's integration into the world where it will spend its useful life. Relative quality refers to product consistency, often called production batch similarity. This means that all products in a batch conform to the same specifications, are made from the same raw materials and possibly even on the same machine setup. Inter-batch variations could exist, such as minor modifications for improved performance or cost reduction. Relative quality refers to the ISO 9000 quality compliance standards.

From concept development through to production ramp-up, many changes will occur to the product and in the production process. This reiterative process of testing and improving the concept has to be traceable in order to backtrack to the last good status. This means that during development many things can change, and when things change they can go wrong. Technical specification conformance can be lost. As long as proper documentation has been kept, the commercialisation team will be able to undo changes until they have reverted to the last good design. The modern innovator may be familiar with the "UNDO" button, but the commercialisation team has to manage this process in order for the "UNDO" button to work as expected.

It could be that more than one viable proof-of-concept is taken through to the commercialisation phase. This is recommended if none of the proofs-of-concept stands out as significantly better than the others, or if there is a possibility that commercialisation parameters could influence the best viable product. In this case, all concepts have to be documented – refining explicit knowledge about the concept while tacit knowledge

is transferred from the innovative researcher to the commercialisation team and in turn to the production engineers.

11. A checklist on what the innovative researcher must do

To successfully manage the research development process from the fundamental phase through to the production phase, the innovative researcher must take responsibility for certain management functions. After working through the text in this book, he could utilise the following checklist:

a. Set basic goals
b. Agree to basic rules
    i. Clearly state risks
    ii. Be critical of shortcomings
    iii. State overlaps with work of others
    iv. State parameter boundaries beyond which outcomes are uncertain
    v. Quantify where possible
    vi. Use analytical analogies where possible
    vii. Supply stochastic probability for all dependent variables
    viii. Point out seasonality
    ix. Normalise to known standards
c. Apply for and secure research funding
d. Transfer his knowledge to the commercialisation team
    i. Transfer tacit knowledge at the hand of explicit knowledge
    ii. Make adequate time for tacit knowledge transfer throughout the commercialisation process
    iii. Make available all explicit knowledge
    iv. Provide support on updates of explicit knowledge
    v. Host workshops on updates of tacit knowledge
e. Publish and/or patent
f. Re-develop and improve the product

12. Application

The doctoral student's main task in the learning factory would therefore be to package the learning levels achieved. Each level must be packaged from both the learner's and the educator's perspective, as indicated in my first definition on how to graduate from

level to level. Packages are then available for following learners, to learn from and to improve, before they, in turn, are allowed to graduate to the next level.

My own industrial experience (mistakes made!) warns me to emphasise here that the packaged learning levels should each be documented (with suggestions for improvement), however insignificant they may seem, to be effectively utilised by the next student. This documentation also serves as proof that the student has progressed through the learning level and is ready to be graduated to the next level of learning. The didactic platform of the learning factory has therefore successfully facilitated the transfer of knowledge.

THEME 7

RESEARCH ETHICS AND RESPONSIBLE CONDUCT OF RESEARCH

RESEARCH ETHICS AND INTEGRITY AND THE RESPONSIBLE CONDUCT OF RESEARCH

LAETUS O.K. LATEGAN, EDITH SEMPE & SUSAN TILLEY

1. The global research agenda and the importance of ethics

Literature confirms that research ethics involves the study of norms and values for research. For the purposes of this book, research ethics is defined as those values and norms pertaining to the responsible conduct of research. However, responsible conduct of research is integrally connected to integrity – the integrity of the researcher and of the proposed research. To conduct responsible, ethical research, researchers, in addition to paying attention to institutional ethics protocols, must also consider the ethical implications of their research as the research process unfolds. When they act with integrity, researchers are able to build and maintain the public's trust.

This interpretation of research ethics, and of the role of integrity in the conduct of ethical research, requires an understanding that:

- firstly, all research is connected with values and norms;
- secondly, research must be trustworthy – ranging from the doing of research, the management and administration thereof and the impact that the research has on society; and
- thirdly, research workers need to be responsible for their research activities.

To guide researchers and scholars, research ethics, responsible conduct of research and research integrity can be contextualised as follows:

- **Research ethics** is a wide-ranging term covering the responsible conduct of research and all of its content. Research ethics involves the application of moral rules and professional codes of conduct to the collection, analysis, reporting, and

publication of information about research subjects, observations, results, and application.

- **Responsible conduct of research** relates to the manner in which all aspects of research are undertaken. The areas that need to be taken into consideration when conducting responsible research are:
  - data acquisition, management, sharing, and ownership;
  - conflict of interest and commitment;
  - human subjects;
  - animal welfare;
  - research misconduct;
  - publication practices and responsible authorship;
  - mentor / trainee responsibilities;
  - peer review; and
  - collaborative research.
- **Scholarly integrity** refers to the professional conduct, ethical decisions, and manner in which teaching, mentoring, research, scholarship, or artistic/creative activities are carried out in the course of a faculty, staff, postdoctoral scholar, or student's work or studies at the university.

The study of research ethics and the application of ethical criteria for the conduct of research are not new interests for the scientific community. This is evident in the large number of ethical codes in place historically and currently, and the best practices that exist around the world. To adhere to research ethics is of the utmost importance to researchers and their institutions because an institution and individual's credibility and integrity will be supported or diminished based on judgments about the ethical conduct observed.

2. Mainstreaming ethics and emphasising integrity in the research process

As a result of the Second World Conference on Research Integrity (2010), the *Singapore Statement on Research Integrity* was drafted. The focus was primarily on responsible research practices and activities. At the Third World Conference on Research Integrity in Montreal, Canada (2013), a number of remarks, comments and discussions again reminded all attendees that research integrity is not an add-on activity but a non-negotiable requirement. At the same time, the attendees were mindful that researchers, student and otherwise, need to develop a deep understanding of research ethics

and what constitutes integrity in relation to ethical conduct. Questions were raised as to whether researchers engage enough in debate about the consequences of scientific misconduct and misbehaviour. Do we sufficiently sensitise our colleagues and students with regard to the importance of respectful research practice? During some of the theme discussions, speakers argued for greater promotion of a more comprehensive understanding of research integrity, than the well-known respect for human subjects, animals, data (neither to fabricate nor to inflate) and authorship (what constitutes authorship?). Reference was made to the impact of research activities on the environment, safety, radiation, security, sustainable livelihoods and the community to whom our research is directed.

Added to the list of areas needing attention were: the professional relationship between supervisor/advisor and students, the benefits that government, business and industry can gain from our research, and the ways in which a value-driven scientific community can be sustained. Everyone was in agreement that research ethics and integrity should be high on the priority list. Researchers and students need to be educated in the demands of doing research and trained to be responsive in a responsible way. Emerging from the discussions following from the keynotes, theme tracks and informal discussions, was a consensus that research ethics and integrity are everyone's business and that scientific research should be rigorously conducted and protected.

The conference discussions highlighted the need for a global approach to understanding research ethics and responsibility, and the importance of the nuances specific to research contexts (i.e., cultural and religious influences on what constitutes research ethics), suggesting that enough commonalities exist across international contexts to build a global understanding of and support for research ethics and integrity. Apart from the many discussions, the conference also produced a *Montreal Statement on Research Integrity* – with a focus on cross-boundary research collaborations. This statement brings value to research groups, networks and partners. Besides, scientific integrity is everyone's concern.

Drawing from the numerous fruitful discussions that took place during the conference, we suggest the following for the consideration of researchers, doctoral students and their supervisors.

First, research ethics is, broadly speaking, those values impacting on our research: do no harm, no greed, be honest, be transparent and accountable, guarantee dignity and privacy, secure and promote healthy living societies. Research integrity contributes to the degree of trust that the public (government, business, industry, peers and

societies) have in the research (including methods, design and application) that we are conducting. Does your research confirm these values and expectations? Don't ask this question only occasionally, but rather at every step of the research process.

Second, never think of research ethics and integrity as something that should happen along the way – the proverbial "tick box" approach. Ethical considerations must be embedded in all aspects of the research process, from the articulation of the research questions to the collection, analysis, representation and dissemination of data and research findings. Questions of ethics are comprehensive rather than solely focused on addressing university or institutional regulations or legal compliance – ethical research honours the deepest driving force of all scientific activities: a search for the truth. How can researchers conduct ethical research, if their work is perceived with suspicion, or if it potentially poses danger to other people? Can they claim that there are no "dirty hands" in their research projects?

Third, in addition to truth seeking, research is also a matter of improving and adding value to everyday life. Resources of all sorts are dedicated to research efforts. Researchers need to remember that when financial support is given to sustain their research endeavours, such monies are not available for other work, no matter how important. They need to ensure that their research is valuable beyond the completed degree or professional advancement that benefits researchers' careers only. When researchers work with human participants, they are asking them to give of their time, their energy, to share their knowledge with them, often without any material gain on the participants' part. Participants and their communities, indeed all of those who engage in the research, need to benefit from the research conducted, if not in the present then perhaps in the future, and if not on a local level, then perhaps on a societal one. Reciprocity is important to the conduct of ethical, responsible research. Who gains from the research? Who or what may be harmed? The science of ethics teaches researchers that ethics is, apart from the study of values, also about the *motive* for research. Why explore this research question and not another? Ethical conduct is also about maintaining the dignity and security of the people, communities and environments involved. The findings of ethical research must make a contribution that includes those involved but moves beyond to the greater community at large.

Fourth, no research is ever practised outside the sphere of support and supervision of peers. Student researchers and experienced researchers receive support and advice from peers who can also guide them to remember the principles of the scientific community. Researchers are members of a community that provides oversight to

secure reliable facts and data and to ensure that questionable research practices and mediocre research results are not deemed acceptable. Researchers who engage in scientific misconduct and/or misbehaviour violate the rights of the scientific community. As a result of their misconduct, individuals, communities and institutions previously willing to participate in the research of others will withdraw their support from the scientific community.

Fifth, any conflict of interest needs to be resolved before research can proceed, and if it cannot be resolved, another plan for the research is needed. Supervisors and students need to be distanced from each other. To supervise or be supervised by a relative or close friend provides a context for conflict of interest that should be avoided. Conflict can also arise in relation to authorship claims. At the initial stages of writing for publication, researchers and students need to discuss order of authorship and contributions to the publication to be made. When no contribution is made, an authorship claim is not credible. Conflict also occurs when money is used for activities beyond the intention of a research grant. It is important for researchers to return to the grant application over the period of the research to remind themselves of the promises they made. Building a responsible research community begins with the researchers themselves.

All researchers should remember what the community of science stands for: a respectful and reliable profession. Scientific misconduct and behaviour are threats to the wellbeing of any research community. Not only is the researcher's reputation at risk: the risk is extended to the reputation of the community of researchers at large. The question for researchers to consider is: would they like to be remembered for their scholarly work and see their name on a list of honour or are they comfortable with being remembered as individuals who have let their scholarly community down?

Today research – international, inter-disciplinary, team-oriented, and often technology-intensive – should be non-manipulative and free from error or distortion. A conclusion that can be drawn from literature and policy review, debates and applications, is that the challenge for ethical, responsible researchers is not limited to a conceptual understanding of ethics alone. Even if an enabling ethical climate can be created, no guarantee exists that researchers will be "ethical" or that they will behave according to ethical expectations.

Hence the questions: Can researchers be taught or trained to be ethical? Can the research community be more responsive to those norms and values associated with a responsible research community?

The characteristics of a research community are built on universally accepted ethical values such as honesty, integrity, loyalty, respect for life, care for the environment, financial accountability for public funding expenditure, research outputs that support human capital development, value for money, responsibility, trustworthiness, no conflict of interest, non-hazardous activities or results, and so on.

It continues to be important to consider how researchers develop an ethical awareness, and what measures might be implemented to ensure that integrity is upheld amongst the high standards of academic institutions. The code of conduct discussed in the next section provides guidance to researchers to ensure that the integrity of the researcher and the proposed research is maintained throughout the research process, from initial stages to the publication of findings.

3. Code of Conduct for researchers

The university expects that its staff and students will carry out the academic project with the highest ethical and scientific standards of academic integrity and performance. Staff and students should adhere to those values that are universally recognised by the scientific community. Staff and students are also expected to live up to the institutional values of the university and the constitution.

The code is based on a broad understanding of research integrity that is reflected in the researcher's behaviour:

- honesty and integrity
- respect for human research participants, animals and the environment
- good stewardship of public resources used to conduct research
- appropriate acknowledgement of the role of others in research
- responsible communication of research results

To give effect to this orientation, a university can expect researchers to adhere to the following ethical principles (see Lategan, 2012):

Dictum of do no harm: The university commits itself to the ethical dictum of *do no harm* in all its research activities. The university further commits to the universally accepted ethical values associated with the protection of human life, responsibility towards animal life, preservation of the environment, contribution to safety, security and sustainable development, integrity in human interactions and relations and the association with the common good.

Paradigmatic choices: Researchers should be free to select the research paradigm for their academic work, recognising that ethical issues take shape based on methodologies and methods chosen. The issues that arise will vary based on these choices. For example, although there will be a similar demand for ethical conduct for all research, ethical issues that arise in qualitative post-positivist research will often differ from the issues that emerge while researching from a quantitative positivist perspective. Researchers have an ethical responsibility to understand the ethical dimensions of the methodology and methods they have chosen. Researchers must be free to form their own findings and conclusions based on scientific evidence. These findings and conclusions should be available for scrutiny and criticism as required by the university and scientific community's principles of fairness, openness, transparency and academic dialogue. It is expected that researchers conduct scholarly work in a way that advances knowledge while maintaining high ethical standards.

Unfair benefit: Staff and students should at all times avoid situations that could contribute to unfair benefit for the individual, or behaviour characterised by greed. Although the university respects the notion of individualism and promotes entrepreneurship, individualism and entrepreneurship can never be at the expense of other staff and students.

Creation of knowledge: Researchers should be committed to the creation of new knowledge that can enhance the vision statement of the university. The creation of new knowledge should promote the technology and innovation agenda of the university. It should by no means contribute to any situation where the safety and security of society is under threat.

Supervision: Teaching and learning at the postgraduate level should be driven from the perspective that the supervisor plays a supportive role in the student's discovery of new scientific knowledge. The supportive role should include assisting students to delineate the research topic, to formulate appropriate research questions, to identify an appropriate research design and to develop the scientific and scholarly skills of the student. The various roles and responsibilities of student and supervisor need to be well defined before the student begins his/her research journey. This relationship depends on mutual commitment to the project and the assignment of clear roles and responsibilities in the supervisory relationship. There will be times when students need more support (e.g., when constructing the plan, or during data analysis) or less support (e.g., when exploring the literature, writing chapters). However, regular communication between supervisor and students is essential as it provides the basis for

ongoing formative assessment and feedback. The student-supervisor relationship is an important one that is built over time and experience.

Research teams: Research teams should behave at all times according to the ethos of their professions, live up to the expressed values of the professional and academic organisations and express collegiality and team work in the research in which they are collectively and individually involved.

Use of information and data: To preserve the integrity of research, researchers are obliged to report honestly and objectively, to avoid error and to disclose all of the important information. Objectivity (or acknowledgement and suppression of bias) is important to both the *a priori* tasks of setting up the research and gathering the data, and in the *a posteriori* tasks of interpreting and publishing the results. Attention to objectivity is critical so that future work built on past research can continue to be assessed as credible.

Obligations of authorship: It is a researcher's obligation to publish results of research so that readers can be informed about the research topic and are able to build on the reported findings. The methods and results should be sufficiently and accurately detailed to meet the criteria of the methodological framework (e.g., quantitative research should be an objective discussion of the significance of results, so as to allow replication). Authorship should be in line with the Vancouver Code that stipulates active contribution in writing the research paper.

Responsible dissemination of research findings: All reasonable steps must be taken to ensure that published reports and public statements about research activities are complete, accurate and unambiguous. If researchers become aware of inaccurate statements about their work they must correct the record as soon as possible. When disseminating findings, researchers must ensure that they have fulfilled their ethical obligations to their participants. If anonymity and confidentiality have been promised, researchers must keep their word.

Stewardship: The principal investigator (PI) of the research is the custodian of the sponsored research funds. In exercising this custodianship, the following principles must be adhered to:

a. Justification: The reason for transactions out of research funds must support the project's goals and adhere to the guidelines of the Funding Agencies as well as those of the University.

b. Documentation: Each transaction must be supported by sufficient documentation. The documentation must be retained, organised and complete enough to stand up to an audit.
c. Timeliness: Transactions must be handled within a reasonable period of time consistent with the time frames outlined by Funding Agencies and the University.
d. Certification: Transactions must be approved by the relevant authorising signatories.

Risk: Key issues associated with research involving human participants are related to: evaluation of the risks and benefits of the research, informed consent, privacy and confidentiality, coercion and rewards. An evaluation of risk should take a participant-centred approach, with the establishment of a threshold for normally acceptable risk. This threshold is generally set by determining the normal range of risk that a participant encounters in everyday life. If the risk inherent in research participation does not exceed this standard, then the risk of participation is seen as being within the threshold of normal acceptance. When minors or vulnerable populations (e.g., children, prisoners, hospital patients) are involved, more attention needs to be paid to the assessment of risk because of the complexities of understanding the "normal range" in such circumstances.

Informed consent: When involving human participants in research, researchers must ensure that participants are fully apprised of what the participation entails. All details must be articulated for the participant including the time and tasks required in the participation. Researchers must obtain informed consent. If participants are adults and not considered a vulnerable group, they can give their consent based on the information the researcher provides. If researchers are working with minors they need to have the consent of parents or guardians. Based on age, the children can provide assent in addition to the parental/guardian consent. For example, school children may be minors but they are themselves capable of agreeing, or refusing to agree, to participate in the research. Although partial disclosure and deception run contrary to the principles of informed consent, the use of these is acceptable as long as sufficient justification is provided. This justification must include: (a) the identification of partial disclosure/deception as the only feasible method for achieving the research objectives; (b) that none of the information that is withheld would cause the participant to refuse participation if the information had been provided; and (c) that the level of risk involved in participation is not withheld.

Privacy: Privacy involves the right to decide the extent to which personal data that is not already in the public domain may be disseminated. Confidentiality ensures that data cannot be connected to a specific participant. Anonymity refers to research involving human participants whose identity is never known (e.g., a survey distributed in a way that not even the researcher knows the names of individuals who participated). The research paradigm and methods influence processes of confidentiality and the possibilities of anonymity and as a result, respect for privacy. When researchers are conducting qualitative research using interviewing as one of the data collection methods, anonymity cannot be promised. However researchers need to ensure that the data is confidential. The participants cannot be connected to data they have contributed (e.g., a participant pseudonym may be used, and no identifying information included in reports or publications). Every step must be taken to ensure privacy and confidentiality in all personal information. If privacy and confidentiality cannot be maintained, it is important that this situation be identified during the process of informed consent. It is also important that privacy be treated within the boundaries of existing legislation. A guiding principle for involving participants in research and/or research-related activities is that of voluntariness. Participants' involvement in research and/or research-related activities must be through their own free will.

Conflict of interest: Staff and students have the obligation to avoid ethical, legal, financial or other conflicts of interest. Care should also be taken to ensure that research activities do not conflict with their obligations to the University or Funding Agency. If any real or apparent conflict of interest arises, this must be disclosed to the relevant faculty research committee.

Execution of discipline: Direct relationships between staff/staff and staff/students must be avoided in the context where discipline must be exercised. In cases where such relationships do exist, the information must be placed on public record. Situations where a spouse and/or child is supervised must be discouraged. Where such cases do exist, an independent staff member must be in charge of executing discipline.

Hazardous material: The use and disposal of hazardous materials for teaching and learning, research, demonstration, or other purposes whether on or off the premises of the university, but whose activities are associated with the university, will be subject to the provisions of existing legislation. Researchers must comply with these provisions.

Disputes: Should any dispute arise out of the above mentioned principles or the application thereof, the university will have the choice/jurisdiction to determine how the matter will be dealt with internally or externally.

4. Pointers to consider

An emphasis on research ethics and institutional oversight of ethical conduct has developed over time to prevent questionable research from being conducted. Clearly ethical, respectful research has an important role to play in supporting the advancement of various institutional and individual goals important to the health and wellbeing of societies in transition. The past reveals the need for some form of oversight to ensure that the research is not used as an avenue for the abuse of power.

Institutional oversight is useful but limited in the work of ensuring that researchers conduct research with integrity. Researchers need to develop a critical lens that turns inward to ensure that they continually ask questions of their research process. They cannot depend on the institution to understand what is ethical in the research context or as the research proceeds. They have to ask that question of themselves. What constitutes respectful research is not an easy question to answer. Doctoral researchers need to be educated to understand the complexities of research and the possible ramifications of their decisions.

This education can be purposeful, gained through specific course content or provided through educational opportunities to explore research ethics within and outside academic institutions.

Therefore, for the university to be able to mainstream ethics and integrity into the research process and to enhance the responsible conduct of research, "good (academic) citizenship" applies to researchers' professional lives, continuous development of systems, procedures and workshops to encourage good research practices.

Reference

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THEME 8

GRANTS AND SCHOLARSHIPS

THE VERY BASICS OF GRANT PROPOSAL WRITING

RIANA COETSEE

1. I want to do research, not raise funds ...

In an ideal world, a researcher – who had chosen to become a researcher and not, after all, a professional grant proposal writer – would have all the resources readily available to do research and not be concerned about anything else. However, in the current research environment, not only in South Africa, but all over the world government funding for higher education and research is on the decline. Researchers, including postgraduate students, are thus increasingly expected to generate research funding and to assist in increasing third stream income for universities and other research institutions. The main purpose of writing a research grant proposal, therefore, is to access funding for research or research-related activities. With many research grants, the doctoral student cannot be the main applicant, as the principal investigator (PI) needs to be an academic staff member or should already have a PhD. It is increasingly expected of doctoral students to write the grant proposal and manage the project on behalf of a study leader or other more senior researcher. There are however opportunities for bursary and project funding that doctoral students can apply for.

2. Grant writing is not only about writing ...

A grant proposal involves much more than just the writing thereof. The grant writer needs to look for funding opportunities that are relevant, then needs to study the requirements of the funder thoroughly, get pricing for budget items, identify potential collaborators, develop the narrative of the proposal, draft a budget and obtain supporting documents. Although all of this seems like an arduous process, and sometimes unrelated to the doctoral research itself, writing grant proposals and managing successful grants have a positive impact on both the doctoral research process as well as on the development of a longer term professional career. A grant proposal forces

a student to establish a specific time line for the research project, to meet deadlines, to build or strengthen relations with other researchers, to clearly spell out the research goals and objectives and to communicate the research idea to a wider audience than simply the immediate academic environment. Adding information of successful grant applications to a *Curriculum Vitae*, especially when awarded competitively, strengthens one's professional profile considerably.

3. Recognising a funding opportunity ...

A researcher may need to deal with two kinds of application processes: solicited applications and unsolicited applications. With solicited proposals a funder explicitly requests proposals for grants by means of a Call for Proposals (sometimes called a Request for Applications (RFA) or Request for Proposal (RFP)), which normally consists of a set of guidelines and an application form. In most cases solicited applications are reviewed on a competitive basis and have clear timelines.

An unsolicited proposal is not submitted in response to a specific request issued by a funder, but rather is submitted to a potential funder who by some means (e.g. a website, media exposure, personal meeting) has made it clear that their interests match those of the researcher.

Research offices at universities normally distribute funder calls to their research communities, and one can also go to specific funder websites or google Calls according to a research discipline.

Although calls may differ from one funder to the next, most funders apply similar criteria when evaluating proposals. There are thus common elements that will be found in the majority of Calls, which are addressed below.

4. The rules of the game ...

Never put pen to paper (or fingers to keyboard) without having thoroughly read the guidelines. Then, by underlining or highlighting key words or requirements, make 100% sure that you qualify for a specific fund. Time needed for studying the guidelines is far too often underestimated and grant writers don't realise to what extent this basic preparation directly impacts on the quality and eventual success or failure of the grant proposal. Funders have established a set of requirements with a specific purpose in mind, even if some of the requirements may seem bureaucratic or a waste of time to the grant writer. Whether you play soccer, tennis, chess or hide-and-seek you will

be confronted with a set of rules, and as the player of the game, it is not your place to question or ignore those rules. The same applies to the guidelines established by funders. Whether you are applying directly to a possible funder or responding to a Call for applications, the process is the same: you either play the game according to the rules or risk disqualification.

It is strongly recommended that you draw up a checklist for yourself so as to ensure that you don't miss any of the requirements indicated in the guidelines or Call. Also add a timeline to keep to, as with most research grant applications you need to attach supporting documents, some of which require signatures from one or more institutional representative, mostly at a high managerial level. For this you may need ample time – at the very least a week before the funder's deadline.

5. Give me the money and I will start thinking about the research problem ...

Often researchers believe that, once they obtained funding, they will somehow be better positioned to determine the need for funding. Unfortunately, this is not how the research grant world works. It is not like going to an ATM, drawing a large sum of money and then deciding what to go shopping for. Without being given a very clear idea of how the grant will be used, for what purpose and by whom, a funder will not consider disbursing even the smallest of grants.

6. Ready, set, go! Getting past the writer's block

In the earlier chapter "From concept to paper" (see Theme 5) many elements were mentioned that have relevance to the writing of a grant proposal, especially with regard to describing your research project. Even though you take cognisance of these elements, and with the funder's requirements in mind you have an idea of where you may be heading with your grant writing, almost without exception the grant writer will experience the "where to start?" frustration. Time and time again the tried and trusted 5 Ws (and now also with 2 Hs added) have proved to come in handy. They are: *who, what, where, when, why, how* and *how much*? Together these interrogatives constitute a perfect summary of the main elements of a grant proposal and should therefore form the basis of the abstract – one of the most important sections of a grant proposal.

If you can give even one or two sentences in answer to each of these questions, you are already well on your way.

So let's tease it out a bit, starting with the most important question:

WHY?

The first thing a funder wants to know is the significance of the proposed research. This refers not only to the purpose you have in mind, but also to what ignited the idea. If the funder does not know upfront why the proposed project is important, not only in the particular research field but also placed within a global context, they will not even consider funding you.

Put in a special effort to explain to the reader of your proposal why your proposed research is important, innovative, timely and worthy of funding.

In the end, the big test you need to pass, is the "so what?" test!

WHO?

The research idea may grab the attention of the funder, and they may consider the research worthy of funding, but to be able to do so they need to have a clear idea of who they would entrust their money to and who will be involved in the study other than the PI. There are a few "whos" to consider:

Who are you, and **who** will help you? In the main body of your grant proposal you will briefly give information about yourself and your local and international collaborators (in terms of skills, knowledge and experience relevant to the proposed project). If it is a collaborative project, it should be clear that each individual has a clearly defined role in the project and that the team members complement one another. If funder requirements allow, you should also attach a full updated *Curriculum Vitae* of yourself and, where necessary, your main collaborator(s).

Where applicable it should also be made very clear **who** your research subjects are. If your research involves animal or human subjects, three things should be well clarified in the grant proposal:

- the sample size and whether it is statistically sound
- ease of access to the subjects
- ethical considerations

Many large international funders also require details of your institution. The "who" in this case will then be your host institution. Usually the Research Office of the university and/or the International Office would have information on the most important statistics of the institution (e.g. number of students, number of academic staff, international

collaborations, international awards and grants, legal status and address of the university, auditing processes, etc.). Funders value institutions where the necessary systems, processes and controls are in place.

WHAT?

The main part of your proposal (often called the "project description") will deal mainly with the "what" of your proposed project. This will cover what your project is about, and what you intend to do. Among other things, you will address "what" questions such as:

- What do I already know about this field of research and the literature covering previous related research?
- What are the important research questions in my field?
- What research has already been conducted in this specific research area?
- What areas do we need to explore further?
- What will be the aims and objectives of our study and what will we do to reach them?
- What will the impact of the study be?

Together with the rationale of the project (the "why" explained above), a crucial piece of information any funder will want is to know what **impact** your study will have. The impact could be immediate, within your specific research field and within your host institution, or it could be broader (nationally and internationally) and more long term.

When funders are considering awarding a grant for a research project, they want to be sure that the results of the project will be communicated to a broad audience, both scientific and public. An important "what" would therefore also be: what will you do with your research results? How will you disseminate the findings of your study, i.e. will you submit an article (or more) to an accredited scientific journal? Present a paper at an international conference? Submit a policy document? Facilitate a workshop, talk to the media, file a patent?

WHERE?

A funder does not only want to know where you are based geographically and institutionally, but also where your research will be done. Make it clear whether you are going to do mostly office, desktop or laboratory-based research, or whether your research will involve field work and travel. Also indicate whether collaborative research will be done simultaneously in one or more countries or whether research will be done together in a partner country.

WHEN

For a funder to determine whether your objectives and research methodology are feasible, they need to know, among other things, the timelines you envisage for your project, including the total duration of the project. No funder, for example, will award funding upfront for 10 years or longer. Funding for even five years is not all that likely, unless the funder specifies that this will be done dependent on review, usually on an annual basis. The most realistic timespan for a research project, if not prescribed in the funder's guidelines, would be on average three years, with the possibility of extension.

Another "when" to keep in mind is: When could the project realistically start after the successful submission of the grant application? With competitive grant programmes, it would be prudent to keep in mind that the results of applications, dependent on how large the funding programme is, could be made known anytime between 3 and 18 months after submission. You should therefore not be desperate to find significant research funding immediately and should factor in budget projections with a project start date of at least 4 to 6 months after submission of your application.

HOW?

The answer to this question – which has much overlap with answers to the "what" question – will have a direct bearing on the methodology of your proposed research. It will also lead to further questions. Do you plan on using quantitative methods or qualitative methods, or both? Do you plan to do clinical research? Or are you proposing to undertake experimental research? How will you evaluate your project and know that you have reached your aims and objectives?

And last, but certainly not least:

HOW MUCH?

The ultimate aim of a research grant proposal, as opposed to a research proposal submitted for postgraduate studies or a proposal for a scientific article to be submitted for publication, is to acquire funding to conduct a specific research project. You must give clear and realistic answers in response to questions such as "How much money do you need?" "Why do you need this much?", "What will the funding be used for?", "Does each line item in the budget clearly relate to an activity described in your project plan?", "Is the cost of this project justified and realistic?", "Is this an all-or-nothing type of budget, or can we choose to fund portions of it?" Often the funder will also ask whether there is any cost sharing, with applicant's host institution or other funding source involved.

7. One size fits all ...

Nothing could be further from the truth when it comes to submitting a research idea to more than one funder. It is very important to ascertain – through the Call for Proposals or the funder's website – what kind of scientific language a particular funder uses, what criteria weigh more than others and what expectations in terms of output and impact that funder may have. Never assume that the reviewers of your grant proposal will be experts in your field; therefore ensure that the title and abstract of your proposal are immediately comprehensible by non-specialists, by avoiding technical jargon and the use of abbreviations and acronyms: rather write these out in full.

8. End of story ...

Always remember that, ultimately, your proposal should tell the story of what you are planning to do, and should provide proof that you will be a competent protagonist in this story: someone who does not beg for money for survival; rather a person who wants to further the goals of the funding body and further science to the benefit of the broader society.

Further recommended reading

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THEME 9

CREATING A COMMUNITY OF PRACTICE

CREATING AN ENABLING ENVIRONMENT FOR EMERGING RESEARCHERS[6]

LAETUS O.K. LATEGAN

What is an "enabling environment for emerging researchers?" Many suggestions have been offered as answers to this question. In my opinion, we need to consider the question from three different perspectives.

First, an "enabling environment" needs to be contextualised.

Second, the position of the emerging researcher needs to be determined, as opposed to that of the mid-career and established researcher.

Third, the contribution of the university should be understood.

1. An enabling research environment

I often battle with the question of whether it is the researcher who contributes to the environment, or the environment that supports the researcher? I don't think there is a final answer to this – for the simple reason that all universities need researchers, regardless of their stage of research activity, output and impact, to build a research environment. This approach guarantees the sustainability of the research environment. At the same time, without being provided with infrastructure, human and financial resources and supportive systems, there is simply no way that researchers can deliver on their research assignment. This leads to the conclusion that an enabling environment is a well-resourced environment supported by the ongoing participation of researchers to develop and sustain this environment. To me the enabling research environment is an environment where researchers jointly take on the responsibility to grow the existing

6 This paper is an updated version of a paper published by the author on the NRF's Emerging Researchers Network (www.nrf.ac.za).

platform for research. This "platform" will then also include aspects such as a growing knowledge base, a culture of innovation and an ethos of further developing what is already available in the university. In essence, this means that there should be a culture of joint responsibility. This "response-ability" (ability to respond to the demands of the research society) refers to what I would like to call the *"H" to the power three* approach: **heart**, **head** and **hand**. To create an enabling environment one requires "heart": the commitment to be a contributor and not only a consumer of the research environment. Represented by the "head" are: knowledge, skills, competencies and abilities which are required to build such an environment. To put the commitment (read "heart") to work, the "hand" is required. The "hand" symbolises that researchers are people practising a particular "craft" and that this craft can only come to life if there is action. The well-known slogan: *don't tell me, show me*! applies here.

Such an approach has specific meaning for emerging researchers. First, all researchers – including emerging researchers – have the responsibility to build a research culture. Second, researchers, especially in the category of established researchers, should act as mentors for emerging researchers. They (the established researchers) should support the emerging researchers in their development *en route* to the next level of research participation and output. Third, emerging researchers should realise that the emphasis is on doing research and that "emerging" is simply the adjective to identify the level of research readiness and participation.

2. The position of the emerging researcher

It is normal practice around the world to identify three categories for research readiness and participation. These categories are emerging/novice researchers, mid-career researchers and established researchers. To me the important part is not what kind of categories or how many categories, but rather what activities are associated with these categories. Typical activities for research participation and productivity are: study towards highest qualification in the field of study; participation in research training, publication writing, conference presentations, postgraduate supervision, research grants, professional research engagement (editorial boards, review panels, assessment panels, etc.); and transfer and innovation. Ideally speaking, research participation and productivity should increase as researchers improve their research training and experience. Emerging researchers should preferably engage in activities to master the research assignment, mid-career researchers should participate in research training and publication writing beyond their formal studies, and the established researchers

should engage in all activities associated with research participation and productivity. The idea of these categories or suggested activities is not to limit research participation but rather to have yardsticks with which to benchmark research development and performance.

3. The university's contribution

In (research) management, I have learned that structure follows strategy. It could be that different universities (depending on their institutional research profiles) may follow different strategies to accomplish their research plans. It may even be that they require different structures to support these strategies. Through the years (as researcher and research manager) I have found that four strategies are required to successfully develop researchers and the research environment:

- The fostering of intellectual activities that will stimulate knowledge growth.
- The development of well-formulated and communicated policies to regulate the development and management of research.
- Resource development and allocations to ensure that people, infrastructure and finances are available to support research.
- The establishment of innovative structures to assist with the management and administration of research.

The meaning of these strategies can be explained as follows:

- Fostering of intellectual activities: Universities are places of creativity. There should be regular seminars and debates on different research topics, (in-house) conferences to create opportunities for researchers to communicate and debate their findings and views on specific aspects of their research, (in-house) journals to serve as platforms for editorial development, to create the opportunity for researchers to familiarise themselves with the peer review and publication process, and so forth. Intellectual activities should lead to a research ethos – a spirit and orientation that research is not a mere added-on activity for the university.
- Many researchers view policies as a hurdle to be navigated in doing research. This is true if the policy has no specific reason for existence or value to add (it is simply adding to the "red tape" of institutional activities). This should not be the case. The orientation should rather be to express the university's position on aspects such as promotion, sabbatical leave, how institutional funds should be allocated and disbursed, who takes responsibility for equipment, and so on.
- Resource development and allocations: It is well-known that resources are no longer limited to funding or infrastructure only. In addition to finance and infrastructure,

there are members of staff and students to be considered. Staff (academic and support) and students are the capital of an enabling environment and the basis upon which sustainability can be secured.

- Innovative structures: Organisations are continuously debating how best to (re-) design their organisational structures in support of the research plan. Most advisable is to have three kinds of structures: a senate committee to identify research strategies and to monitor the output, outcome and impact as a result of the inputs and processes associated with a research plan; faculty research committees to monitor growth of researchers and the research output in specific research programmes; and a research platform where ideas can be discussed and new trends and developments in a research field can be unpacked.

These research strategies should be captured in a research plan that is managed on the basis of inputs and processes (contributions to the research activity), outcomes and outputs (spin-offs as a result of the inputs and processes) and impact (did the research results change/improve society, practice, behaviour, etc. or did they lead to new government policies in support of national developmental objectives?).

The perspective that I would like to promote is that emerging researchers should be afforded the opportunity to grow their research expertise and at the same time also take on the responsibility to contribute to an enabling research environment. In addition, the university (as a system) and mid-career and established researchers (as participants in a research system) should form a network in support of the emerging researchers.

DEVELOPING A RESEARCH COMMUNITY

A reflective journey of an Austrian scholar in a positivistic setting

MARTINA GAISCH

1. A personal account

It all starts with an idea, a creative thought that you wish to pursue academically. But how? Whom to address? Where to start and what to read?

In the following, my own doctoral journey will be reflected, some tips will be given and a general outline for a PhD endeavour will be provided.

As an educator of English and intercultural competence and higher education researcher, I have come to understand that the study of language, isolated from any context of language use, would contribute but little to the understanding of socially constructed processes. This was all the more true in view of the setting where I was operating.

I work at an Austrian university of applied sciences, more precisely at the school of informatics, where I am one of the rare female academics, who also underwent a substantially different epistemological socialisation. Most of my colleagues were educated in the objectivist paradigm where the goal of learning is, above all, knowledge acquisition. According to Kuhn (1970) the way that scientists judge contributions and agree on their reliability and universal truth leads to a shared perception of the world with visible outcomes and considerable headway in science in general. Hence, hard scientists tend to venture seldom into foreign research territory: rather, they tend to stick to objective issues that are more tractable. As such, the boundary of science is defined by how successful it is to reach agreement on the means of research, on the basis of utility and convenience.

In contrast to the objectivist mind-set, scholars or soft scientists have a tendency to co-construct knowledge with the knowers. Accordingly, my study is framed through constructivist epistemology and the methodology of constructivist grounded theory. From the outset, I was interested in an approach that did not define the exact scope of the research problem, but rather focused on the emergent nature of a nexus of interrelated relationships. Additionally, I found it more challenging to generate a theoretical framework grounded in the data than to describe some themes, test some hypotheses or confirm pre-defined concepts.

It soon became obvious that such a stance required a non-linear and multilevel perspective to grasp the intertwined and dynamic emergence of a gradual process taking place at the investigated unit of analysis.

This also meant that I had to accept a rather inherent vagueness and ambiguity during my early research stages which presupposed a high degree of sensitivity and openness. On a positive note, this high level of uncertainty went very much in hand with a good portion of (self-)reflexivity, an element that I also sought to examine later on among the investigated social agents.

There is no doubt that all researchers that embark on a PhD journey enter the final straight with a wide range of newly acquired skills. This also applies to me and my own transformational learning process has been translated into a number of factors which are briefly outlined below.

First, my growth as a researcher has made me more reflective in many regards. I have started to reflect more critically on my own research agenda and the responsibilities that I have towards my participants and colleagues. Informed by a wide range of theoretical perspectives, I have developed a greater capacity to perceive, observe and interpret the social world around me from multiple perspectives.

By reading widely in such areas as sociolinguistics, higher education research, social sciences, perceptual psychology and the field of qualitative research in general, I gained more confidence in drawing from a number of different theories, approaches and paradigms. I started to feel increasingly comfortable with combining different elements of theories in an eclectic manner that ultimately appeared best suited to generate my grounded theory.

I also felt that my capacity for conceptual integration of the data and analysis of the emerging framework constantly improved so as to yield plausible interpretations of the findings.

One tension that I was subjected to was the widening gap between my lived experiences as a mother, wife, daughter, friend and English teacher, and the emerging theoretical understandings that were guiding me through this research journey. I became increasingly immersed in the deep sea of knowledge that my research fields brought about and found it extremely difficult to switch off. I must admit that I even started to withdraw into the "ivory tower" where I felt more and more at home.

Another challenge was caused due to fluctuations of emotion and the – I believe – normal ups and downs during a project of this kind. There were times when I felt highly enthusiastic about my work and the progress that I had made. Then there were occasions when I was stuck and overwhelmed by the breadth of information that appeared to be hardly manageable. More than once, I embarked upon a path that did not lead to success. However, despite these critical moments, I am happy with the end result, both in terms of the end product and my own research process. This process has ultimately broadened my repertoire of theories and practices, increased my capacity of critical reflection and will hopefully also be a decisive factor in my future career.

As such I had hardly any pre-conceived framework of ideas that would point to a linear direction which was reinforced by my stance as a constructivist; for it is my firm belief that data is neither collected nor discovered, but co-generated due to a constant interaction between the researcher and the investigated social actors.

2. Developing a research community

So, in sum then, I would like to point future PhD candidates to the following issues when developing a research community: be aware of the different research paradigms and find your way through the variety of research methods. Make sure you read widely and start to interpret and critique scientific papers in line with your research focus. In doing so, not only is the availability of journals crucial, but so also is your critical reflectiveness of the generated outcome. Become a member of a networking site for scientists and researchers to share papers, ask and answer questions, and find collaborators. Follow and interact with researchers whose contributions interest you. Attend conferences that are in line with your research fields and network with such communities as much as possible.

You never know: you may find interesting opportunities to seize!

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LESSONS LEARNED FROM MY JOURNEY

A female researcher's perspective

NTSOAKI MALEBO

1. Making a choice

I grew up in a small town in the northern part of the Eastern Cape Province, called Aliwal North. Growing up in a small town is a challenge for any young person as such towns are often characterised by high levels of unemployment and poverty. You can either get a job that does not require post-schooling education, or leave town to find other opportunities that include tertiary education.

Now, leaving a small town, especially as a young woman, is often not easy; you may have to make a choice between getting an education and leaving an ailing parental figure behind, possibly a parent, a grandparent, or any of a number of extended family members. When you have made the choice to leave, you face the challenge of finding funding for university registration and accommodation. I was one of the fortunate few who did not have to face such struggles, as I had my mother in the "big city", and she managed to accommodate me and get me a loan for my first degree. As a young woman who was raised by a single mother and the first one in our family to go to university, expectations from the family were high, and failure was not an option. The first years of university was characterised by making sure that I did not disappoint my family while at the same time trying to impress my peers – often a recipe for disaster. Once you know what you want you, however, you focus and work hard and finish that first degree.

2. Lessons learned

Once you finish your first degree you realise that nothing ever goes according to plan. This is one of the first lessons I learned at university. My plan was to go to university, graduate and get a job. My family was expecting the same. However, as I said,

nothing goes according to plan; I could not get the job I had studied for so I had to settle for being a receptionist for two years before I could pursue my studies.

The reason I settled for that job was lack of information. At the time I did not know that you could get a bursary from the National Research Foundation to pursue your studies. Once I had this knowledge I left my job and went ahead to do my honours degree. As a young black female, my family could not understand why I would want to leave a paying job "to go back to school". The fact that I could not get the kind of job I had studied for was conveniently forgotten. I now had to convince my family of the importance of continuing with my studies: we live in a competitive world, I said. In order for me to compete and get a better job I need better education, higher education. My family was not convinced by my argument; reluctantly, however, they let me go to pursue my "second degree".

Consequent to my "second degree" I graduated and told my family I had found a supervisor who believed that I should continue and start working towards a master's degree. The euphoria of seeing their daughter graduating for the second time meant that this time I had their blessing to commence with my "third degree". This euphoria however did not last for very long as at family gatherings I would be asked: when are you completing your schooling and getting a job? My personal favourite question was: what are you going to be when you complete your degree?

To date I'm still trying to explain to my family what it is that I do on a daily basis. Be that as it may, I realised that in order to complete a successful postgraduate study you need the support of a supervisor as well as support at home. This was the second lesson I learned: without support your journey will not be easy. So when identifying a supervisor it is important to choose someone in the same field, a mentor with a passion for science: a person who has a good track record of student guidance and supervision always makes a good mentor. When a mentor has a good publication record with students as authors and the ability to attract funding, you know you have struck gold. My supervisor for my master's study continued with me from honours, his passion for science making me want to continue on my journey as a young scientist. He created what he used to call the "buddy system" where doctoral students would support and guide younger students. Through the "buddy system" I was able to get mentors who assisted and supported me in my journey in the laboratory. My mentors would guide me when I conducted my experiments, and they assisted me with handling the constructive criticism that we would get from our supervisor. At master's level I soon learned that my "sweet" supervisor was not so sweet anymore: he pushed us to be the

best! In the end his pushing paid off when I presented two papers overseas, published two articles and graduated cum laude! Support from home was also critical as I fell pregnant just before I completed my master's degree. The support I received from my family enabled me to get to where I am today.

I stayed with my supervisor who soon showed us that your career begins when you start your master's degree. This is the time when you start building your track record, through presentations at international conferences and publications in international journals. During your master's degree studies you also able to determine whether you are in the right field or not, and you begin to be prepared for the next step, which is PhD! A master's degree is your launching pad. Once you have been launched, use your PhD to position yourself by designing your own projects from gaps that were identified during your master's project. While designing your own projects it is important to keep research globally competitive yet locally responsive. The only regret that I have is that some of the research I did in my studies was not responsive enough to local problems. It resulted in articles in international journals and enabled me to present papers at international conferences but it never really addressed some of the challenges we currently have in South Africa and the central region specifically. However, it afforded me opportunities to travel the world. Travel is important as it provides crucial links for your future career through various networks. While doing all this, never forget to try and find your niche area. One of my regrets is that I wasted so much time trying to be a "jack of all trades". Finding a niche area sooner enables you to position yourself quicker; your profile will develop and your name will be synonymous with a specific research area and this will assist to advance your research career.

3. Pursuing a research career

Going forward and growing as a young researcher I've learned a few more lessons: one of these is that it is important to plan, especially when you are a young mother, so that you can save time. As a young mother I've also learned that not everything goes according to plan so some flexibility is required when planning. When in a laboratory setting always do your own work. It is great to get assistance from technicians who will reduce your work load, but you might miss an opportunity to learn. Dedication can get you through the toughest times, like working during weekends while your peers are partying the weekend away. While working on weekends with your mind in the laboratory and your heart somewhere else, you might get results that you won't understand: never throw these away as they might lead to breakthroughs in the future.

For me they resulted in a publication that was profiled in the local newspaper "Express". During demanding times in the laboratory, your fellow postgraduate students are the best support structures and also make the best future networks. When I was busy with my studies they understood exactly what I was going through and provided the best advice when I received criticism. Currently, they are my research collaborators on various projects. My former supervisor is my means of access to equipment that I currently don't have, while technicians assist when it comes to knowledge generation and training. These relationships have to be sustained and appreciated at all times as they will advance your research career.

4. Enjoy the benefits of a research career

You might want to ask, what are the rewards of a research career? The rewards are endless; you get to share your work on international stages through publications and at international conferences. Through travelling you get to network and make new contacts that will assist you to advance your career. I currently have researchers I have encountered through my travels who provide me with access to their laboratories to use equipment that I don't have access to. Travel also enhances your chances of meeting possible reviewers for grant applications and even examiners for your students. International conferences also improve your chances of mobility should you prefer to conduct a PhD or post-doctoral studies overseas. My career has even given me a chance to be part of a collaborative project between my home university and the University of Kimpa Vita in Angola.

I was also invited to the 5th Hope Meeting with Nobel Laureates when I received a chance to present my work in the presence of Nobel Laureates. I currently review journals and assist in review panels for grant applications.

All this became possible because of my career; be that as it may, I always remember that charity begins at home so I always do what I call "the extra stuff".

Getting involved in projects that will enhance the community around us is important; at the end of it all, this is all that matters: bringing change to our communities.

So what is my message to other young females? Do what you love, plan and manage your time well, choose a nurturing environment in order to position yourself properly, get yourself support structures and build networks and do not forget to do the extra stuff and remember to be globally competitive yet locally responsive.

LEARNING COMMUNITIES

Essential companions on the doctoral journey

HENRIËTTE VAN DEN BERG

1. It does not stop with the qualification

In this chapter, I reflect on my experiences as a doctoral candidate and how these experiences influenced my career as a research development practitioner, supporting doctoral candidates in the successful attainment of their qualifications.

The contrast between my experiences as a doctoral candidate and that of my training as a master's student in counselling psychology resulted in a firm belief that the quality of doctoral education depends to a large degree on the opportunities offered to students to engage with diverse learning communities to help shape their learning and academic identity. This resonates with the ideas of Austin (2011: 13) and Nerad (2012: 63), who propose that doctoral education requires a community of practice which recognises the role of peers as learning partners, and empowers the candidate to engage with an extended network of participants in a broader learning community.

My doctoral journey was characterised by isolation and autonomous learning activities, such as reading and writing, interspersed with infrequent discussions with my supervisor. The autonomy was beneficial for my productivity, but I soon realised that the expertise and resources which I needed in order to become a successful doctoral candidate are to be found in not just one individual, nor in one department, but in many experts with diverse ideas and perspectives, who could challenge and stimulate me.

My relationship with my supervisor allowed me sufficient autonomy to search for national and international experts with whom I could exchange ideas and build a knowledge network to tap into. This network was situated in an international research association in my field of study, and it became an important partner in my research journey.

My master's training instilled a strong sense of agency in me and this empowered me to take control of my doctoral quest to find the guidance, support, and resources I needed. In my current work at a postgraduate school, I regularly encourage candidates to assert their sense of agency, to identify their professional and personal development needs, and to find the opportunities that can help them to address these needs. The role of our postgraduate school is to share information about resources and opportunities that can promote the development of all candidates. With today's technological advances, a range of online – in addition to more traditional – resources are available to promote the research development of on-campus and distance students.

My master's training involved a gradual initiation into a professional community which provided diverse opportunities to acquire the knowledge, skills, and attitudes necessary for a demanding professional career. It involved a structured process of developing critical competencies through various interactive processes. These processes included formal lectures, workshops, student seminars, individual and group mentoring processes, as well as informal discussions with staff who shaped my thought processes, challenged my ideas, and offered diverse views.

In contrast, my PhD experience was a narrowly focused process that guided me through the completion of my thesis. My supervisor's feedback made a significant difference to the quality of the final thesis, but on reflection, it did little to propel me over the threshold of new insights or paradigmatic shifts. Literature on doctoral education (Austin, 2011: 11) emphasises the interdependence of cognitive learning processes and the social context within which the learning takes place. I therefore support the notion that a rich learning environment filled with diverse voices from academics from different disciplines and orientations as well as inputs from industry and professional partners contribute to higher quality doctoral education and have a much better chance of producing doctorates that reflect the competencies cherished by academic and non-academic employers. The postgraduate school I am working at therefore provides a wide range of development opportunities presented by staff from different faculties, national and international guest lecturers from different disciplines and diverse theoretical orientations to supplement the training students receive in their departments and to ensure that they have the opportunities to exchange ideas with scholars from different backgrounds and disciplines.

Another major difference between my master's and my doctoral training was the role that students played in each other's training and development. Even though I worked at the institution where I completed my doctorate, opportunities to engage with a larger

community of doctoral students were limited, in contrast to my ongoing engagement with peers during my master's training – where a cohort of students shared a working space in close proximity to staff members, closely supported one another, and served as a critical audience of each other's work. As students from different backgrounds and ages, the collective work experience, knowledge and skills of the group became a valuable resource that benefitted the whole group. Peer engagement and support is especially important for part-time students, graduates from other universities, and especially international students, who experience many challenges as they adjust to new environments, new people, and different cultural contexts. Research training activities offer newly registered candidates opportunities to meet other students and to feel more connected to the research community.

I often observe a pattern of frequent attendance of postgraduate school activities in the early stages of students' doctoral journeys and then gradually they attend less frequently as they establish their own network of support on campus. Seddon (2010: 226) emphasises the use of electronic communication technology to provide opportunities for online engagement with research communities. The growing market of technology-assisted research discussions, writing, and support networks testifies to students' need for interaction and engagement, and how technology-assisted interaction can fill these needs.

In both my doctoral and master's journeys, feedback played a critical role in my development. As a cohort of student-psychologists, we were encouraged to give and receive feedback on presentations and written work. This taught me to respond to critical feedback effectively, and prepared me for an academic career in which critical scrutiny of my work is ever-present. Teaching supervisors how to give constructive feedback, and guiding students to look at their work in a critical manner, builds students' confidence and prepares them for the challenges of doctoral learning (Wisker, 2012: 215).

2. Concluding reflections

Looking back at my development as a researcher, I realise that just as my master's training laid the intellectual, interpersonal, and emotional foundation for my doctoral journey, our current doctoral candidates enter the programme with a range of attributes and competencies which can be used to promote the successful completion of their degrees. Our role as supervisors and research development practitioners is to challenge candidates to actively engage with the development of their knowledge

and skills, and to encourage them to become active members of a series of learning communities which will prepare them for the intellectual and social demands of their careers as knowledge workers.

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TEAMWORK IN RESEARCH

Together we are stronger

KOBUS VAN DER WALT

1. Why teamwork?

Doctoral students often feel lonely and isolated in performing their research. These emotions have been observed and commented on by a number of researchers over the years (Grant-Vallone & Ensher, 2000; Hadjioannou, Shelton, Fu & Dhanarattigannon, 2007; Hartnett & Katz, 1997; Lovitts & Nelson, 2007; Nyquist, Manning, Wulff, Austin, Sprague, Fraser, Calcagno & Woodford, 1999; Weidman, Twale & Stein, 2001). At undergraduate level, students form part of classes that study the same material. This gives them a sense of belonging and security since they can discuss and work on problems together. When advancing into the postgraduate environment, they have to investigate a specific research topic which is often not directly related to research performed by other students. This can lead to a feeling of isolation, and students easily become disheartened with their studies, resulting in many of them progressing slowly or abandoning their studies altogether.

The role that the supervisor plays in keeping the doctoral student motivated through the study is important, but it is just as important for the student to meet with his/her peers on a regular basis. Although their research areas and topics may be different, the fundamentals of research remain the same across all disciplines.

2. Advantages of teamwork

Some of the advantages of students working together as a team in a research group are the following:

Peer assessments of written work

- Students often find it difficult to formulate the logical flow of their dissertations. Discussing this with fellow students in the group will help them to think more logically about their work.
- Subject-specific terms and concepts become general knowledge when students work in a research field for an extended period; terminology may be used in a dissertation without explanation and someone unfamiliar with this field may not understand. If a group member from another discipline reads the student's work, it will soon become apparent that more information may need to be provided.
- Students starting out with research are sometimes intimidated by the high standard of articles and dissertations they read and may be reluctant to submit their written work to a supervisor, feeling that their work is inferior. Asking peers in the group to read and comment on their work will give them more self-confidence and thus help to them to overcome this initial fear.
- When students' work is read by other group members, obvious spelling and grammar mistakes may be identified. Through this process the students learn, and the load on supervisors may be lessened because mistakes that need correction will be fewer.
- Students at a more advanced stage of their research will be able to assist students just starting out with common problems such as finding literature sources, referencing, compiling a protocol etc. This also helps to alleviate pressure on supervisors.

Emotional support

- Emotional support from the group may encourage postgraduate students to continue with their research, especially when they become discouraged. Running into problems in one's research, for example when experimental results do not match with simulation results, can be very demoralising. In situations like this, the encouragement of other members of the group can be very helpful.

Peer pressure

- Students not progressing with their research may experience a sense of peer pressure when other members of the group progress faster than they do. This may encourage them to work harder so as not to lag behind.

Presenting research results

- One of the most daunting experiences for young researchers is presenting results of their research in public. Encouraging students to present their work to the research group will assist them to gain valuable experience and help them build self-confidence in a less stressful environment. Presenting their work also forces them to think logically about the flow of their work.

Supervisors and departmental research managers should facilitate meetings for postgraduate students in departments to establish research groups. Meetings of the groups should be as informal as possible to encourage open dialogue for students to discuss their problems. Whenever possible, the meetings should also be attended by the student representative from the Departmental Research Committee (DRC). This will establish a direct link between the postgraduate students and the DRC through which problems or questions may be directly communicated with the department.

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THE CONFIDENCE OF INTERNATIONAL RESEARCH EXPERIENCE

PHILINA WITTKE

1. The value of international travel

"I visited Germany on a short term research stay," Tebogo Makhubela (2015) from the University of Johannesburg tells us excitedly, "and I visited the whole world."

For his PhD thesis, he conducted part of his research at the Helmholtz Research Centre in Potsdam. "I loved being there because of all the lovely people who work there, as well as all the laboratories I could visit to view and learn about the state-of-the-art instruments and equipment they have. That place is the ideal Disneyland to any geoscientist and I feel very lucky to have worked there with highly skilled people from different parts of the world" (Makhubela, 2015).

This is exactly what many young international researchers experience. The PhD thesis period of one's life is an ideal time to conduct research abroad and gain that international experience that will be a unique selling point in an academic as well as a corporate career. Young researchers need to know the professional dialogue in their fields, work in international research groups and on projects to exchange thoughts and ideas with the global peers in the field because international experience builds the character. It makes them grow and develop mature skills. It makes them ambassadors for their countries and a brand for their home science landscape.

We need more researchers of this kind. Major challenges such as climate protection, civil security or future energy supplies can only be solved on the basis of comprehensive research and the innovative development of doctoral students.

Marc Kirschbaum, architect and professor at the University of Kassel (Germany), is a European academic who went to England during his studies. What were the benefits, we asked? "Of course, the language that I improved helped me as well as the self-

confidence. But also the society as a whole benefits from this international research experience."[7]

This is true for Europe, for Africa and for the whole world. Problems and research topics are no longer isolated and restricted to certain countries only. Research is conducted everywhere under the eyes of the world. One might as well embrace this reality and integrate it into all research from an early stage.

Future-oriented solutions only happen when the best minds in a field work together, says Wolfgang Minker, professor for Engineering and Computer Science at the University of Ulm (Germany). He continues: "The advantage of intercultural diversity is tremendous. My experience is for example that Russian students work more theoretically. And because we work in a more application driven way, the theory is a useful input. Thus, we gain a complementary cooperation which promotes the research project as a whole."[8]

If researchers learn this kind of cross-thinking during their PhD years, they can contribute hugely to the ultimate goal of solving the world's problems. Innovative thinking becomes a habit. Innovation is eventually the state of mind. "Successful research projects are today more than ever international programs that live from the exchange of knowledge and ideas of mobile researchers,"[9] says the secretary general of the German Academic Exchange Service (DAAD), Dr Dorothea Rüland (2012). The same sentiment is echoed by Gordon Wagener (2013), Chairman of the Design Division at Daimler AG who went to London during his degree studies: "London was such an inspiring city. But what I appreciated most during my research stay was that there was an incredibly high level of learning because the quality of a research ultimately depends on the quality of the people that are in the room. You learn the most when you challenge and stimulate each other."[10]

7 In: Dem Ziel näher gekommen. Alumni aus 25 Jahren ERASMUS-Programm berichten. ("We got closer to the goal. Alumni from 25 years of ERASMUS tell their stories"), 2013, p.73, translated from German by Philina Wittke.

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Thus, besides the many structural benefits of cooperation on departmental level, or networks to answer socially and globally relevant questions, the individual researcher benefits in at least three ways: personally, professionally and societally.

Katja Irle (2013), freelance writer and journalist in Frankfurt, highlights: "I had to hold a presentation in Italian, a foreign language for me then. That really got to me. But when it worked out, it just clicked. Ever since then I had no more fears to speak in front of an audience. And when I came back home from Florence (Italy), I was very clear in my mind. I knew what I wanted then. I knew that I had made it in Italy and that gave me self-confidence. This effect just cannot be overestimated."[11]

Furthermore, professional skills are clearly developed and the understanding of the whole research topic deepens. When Carsten Wilm (2013) studied law for a semester in Sweden he was able to see his own legal system in a whole new light, and also to question it. "For me, it was a truly valuable experience to learn that systematic knowledge is relative."[12] Today he works in the German diplomatic service and still uses that experience.

Nevertheless, as much as these benefits might make perfect sense on paper, young researchers sometimes don't know where to start, where to find a research group overseas in their field or how to find a supervisor. Luckily, a few organisations specialise in this field of mediation: The German Academic Exchange Service (DAAD), Campus France, the British Council and Nuffic for the Netherlands are the partners for Europe, while Fulbright is the contact organisation for the USA. They offer information on the study and research landscapes of the different countries, on admission processes and funding schemes. They organise Alumni events to speak to people who have actually been abroad and they offer workshops on academic skills. These are the people to start with.

Nicole Schweikardt (2012), of the Department of Computer Science in Frankfurt, confirms this story when asked how DAAD supported her with her research stay: "Well, first of all, they financed my livelihood, including traveling costs and book money for my twelve-month research stay in Scotland. But also, they gave me important

11 In: Dem Ziel näher gekommen. Alumni aus 25 Jahren ERASMUS-Programm berichten. ("We got closer to the goal. Alumni from 25 years of ERASMIS tell their stories"), 2013, p.43, translated from German by Philina Wittke.

12 In: Dem Ziel näher gekommen. Alumni aus 25 Jahren ERASMUS-Programm berichten. ("We got closer to the goal. Alumni from 25 years of ERASMIS tell their stories"), 2013, p.35, translated from German by Philina Wittke.

information on the living conditions in Scotland, offered practical tips on how to find a place to live, where to shop and what insurance to sign. Even when I finished that research stay, they still made me feel like part of the family."[13]

In response to the question of what she experienced during her stay, she says: "During my postdoc, I established contacts with a lot of other researchers. I learned about new research fields and methods. I could experience a different university system and I took part in international conferences. That gave my whole career a direction" (Schweikardt, 2012).[14]

Thus, for young researchers with a PhD or in the postdoc phase, an international, successful research stay is the perfect first step into a research career. With a new and highly topical research project, the young researcher can easily establish her/himself in the science community.

You might want to say now that these are all important people, they have doctorates, own companies and fill political positions. They are great people who have made great careers. What do they have to do with me? Remember what got them there: personal growth and self-reflection, professional expertise and intercultural experience, a network of people and knowledge of different systems.

So, this is what you get when you dare to go abroad: the confidence of international research experience, a stand in your field and an unlimited perspective.

Together, we can reach that goal. Let's go for it.

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POINTERS FOR DOCTORAL EDUCATION

EDITH SEMPE & SOMARIE HOLZHAUSEN

1. The importance of doctoral education

Doctoral education is increasingly being considered as an asset by employers and governments all over the world – it contributes to attributes, skills and knowledge, and it opens up advanced leadership positions in the knowledge economy. Becoming an expert in your field and improving on career prospects involves engaging in advanced studies and research. This necessitates universities and potential students to respond to the increasing calls for doctoral education and the need for a more comprehensive human resource development framework.

Processes and support arrangements for doctoral education will vary in different institutions. This section aims to identify some of the key points or guidelines that are important and that need to be contained in a human resource development framework towards supporting doctoral education.

2. The role of the university in the advancement of doctoral education

The most important role of universities in advancing doctoral education is the creation of a research culture as a basis for how a university education works, the intellectual life blood of the staff, the fundamental support of teaching, and a basis of support for the community. Research embraces the systematic generation of new knowledge, development of new ideas and experimentation with new techniques. These activities inform learning and provide an intellectual platform for engaging in knowledge transfer and interaction with the wider society.

Therefore, for a university's doctoral research to be competitive and relevant, it should have initiatives that create a culture that enables an environment for research, doctoral education and development of human skills. The initiatives can be translated into a human resource development framework comprising the following key elements:

Policy and systems development

The university has a responsibility to provide honest advice and appropriate policies and structures, and to equip researchers with the tools to advance doctoral studies. This includes policies such as sabbatical leave, research incentives and support structures for research development and grant management.

Resources

Based on the research mandate and expected outputs, the university provides financial, physical equipment and human resources such as laboratories, library facilities with the relevant qualified staff to offer on-demand assistance, research software, and availability of computers with Internet access, postgraduate school, research and development support, and other relevant and necessary resources. Provision of resources is done by leveraging from both internal and external funding sources, including subsidies, incentives, research grants, fee paying services and donor or foundation funding.

Intellectual skills development

The university should encourage active participation of postgraduate students in activities that are aimed at enriching and supporting their research work – the *postgraduate student experience!* There should be compulsory active participation in the research calendar activities such as induction workshops, conferences, seminars and publications.

The activities should be part of a formal researcher development programme which includes workshops and training events on different topics and skills in doctoral education, conferences, study visits and internal journals for publications for novice researchers as well as international journal publication in collaboration with the supervisor.

Focused group development

In some instances there is a need for the university to redress the legacies of past practices or challenges created by current realities. This will include introduction of focused programmes to address such challenges. For an example, there could be

special programmes designed to attract and advance women researchers, emerging researchers, or post-doctoral fellows.

Coaching and mentorship

Mentoring gives researchers the opportunity of talking to someone who may have had similar experiences but is further ahead in their career. Discussions with a mentor could include the following topics: career options; routes to career goals; information/ people/networks of potential help to them; feedback on fellowship applications or Curriculum Vitae (CVs); and balance between work and family.

The main difference between a mentor and a line manager is that the mentor has no personal responsibility for performance. The mentee may also wish to discuss career plans with his/her line manager and they should ensure they do not neglect this option during the mentoring relationship.

3. Doctoral supervision

The role of academic staff as doctoral supervisors has undergone significant change in recent years, and this has become an increasingly important aspect of doctoral education and academic practice. Support arrangements for doctoral supervisors may vary in different universities and/or faculties, but there is a strong recommendation that both new and established supervisors should attend short training courses on doctoral supervision.

Before commencing with research, the following issues should be clarified between student and supervisor:

- The roles of the supervisor and the mentor
- Managing supervision meetings
- Ethical issues
- Supervisor/Student contract which contains the study plan, outputs or milestones, timelines and evaluation section for both supervisor and student.
- Student complaints and appeals process
- The researcher development programme and other developmental opportunities for postgraduate researcher students within the university and/or externally.

4. Building your research career – doctoral education

Individual researchers share the responsibility for and need to pro-actively engage in their own personal and career development, and lifelong learning. Researchers should recognise that the primary responsibility for managing and pursuing their career is theirs. Accordingly, they should identify training needs and actively seek out opportunities for learning and development in order to further their career and remain relevant with the choice of research field and topic.

The starting point for potential students in doctoral studies is to familiarise themselves and be inducted into the institutional systems and requirements of the university where they are enrolled. In addition, researchers need to know the criteria and requirements of the external funders or grant providers. The research work should fit into the pillars or key priority research areas of the institution and also be aligned to regional, continental and global strategic imperatives. *Be relevant – provide solutions to current and future challenges!*

5. Research progress

The research process should be planned and managed as a project. Thus the planning routes involve key elements such as:

Developing a research focus

Provides a broad research question on why the research is necessary. The aim of the research should be broad enough to last six or more years and focused to allow coherence, interest and inspiration – *how do you make yourself relevant?*

Producing written research outputs

Caution should be exercised by the researcher by striking a balance between matrix outputs and research career – avoid quantity at the expense of quality. Participation in the production of peer reviewed publications in local or international journals is imperative, as well as in the publication of chapters in books and production of patents. If publications involve multiple authors, be aware of your position on the list; and as a single author you need to also be aware of the quality of the article.

Keep your CV up to date and market your publications – register on platforms like Google Scholar, ResearchGate, LinkedIn and so forth.

Researchers can learn a lot from a lost research grant or a declined publication – do not be deterred by "rejection".

Conference participation

Participation in conferences is important for developing your research profile, keeps you informed of new developments, and provides opportunities for networking and marketing your research. The choice of which conferences to attend should be informed by considerations such as research discipline, participants and venue (international versus local).

Sabbatical leave

Sabbatical leave allows the pursuance of academic growth through research and/or the improvement of postgraduate qualifications and exposure to business and industry. Sabbatical leave requires planning; develop a sabbatical plan which will define when and where best to take the sabbatical, what advance notice is required, plans to deal with your supervision responsibilities, funding applications and what research needs to be completed before taking sabbatical leave.

While on sabbatical leave other advantages can be gained – conferences, laboratory visits, field experiences, etc.

Developmental opportunities

Based on the research focus, the researcher must identify opportunities to take advantage of in enriching and supporting research work. These opportunities can include industrial visits, prospects provided by the university, external funding, scholarships, research councils, and so on.

Collaboration

Collaborations through cooperative arrangement with other researchers to work jointly towards a common goal are essential in doctoral education. This is an effective method of transferring 'know-how' among individuals, therefore critical to creating, enhancing and sustaining human skills development within doctoral education.

Selection of collaborators should be done carefully. Partnerships and collaborations should be meaningful and should result in the further development of a researcher's CV. Negotiate the terms of the partnership to benefit the researcher's career.

Funding

Research is often dependent on funding. Funding agencies will provide funding based on research reputation/relevance, quality, coherence and outputs of the research. Therefore, allow plenty of time to write a good proposal, note deadlines and look out for internal deadlines which are imposed to help improve submission before onward submission to the funding agency.

Plan your proposal submissions so that you have a grant at present, one or two that have been submitted, and one or two that are still being written. It takes anywhere between three and twelve months for funding decisions to be made.

The researcher needs to balance the institutional matrix outputs with the funder's outputs in advancing the research career.

Internationalisation

An international footprint is essential for the development of a research career. It contributes to the ratings of the research, as well as to the researcher's reputation. Internationally collaborated papers are cited more often than other papers.

6. Summative comment

In conclusion, doctoral education is critical in developing the ability of universities to transfer and exploit knowledge where appropriate, and to facilitate its use in the researcher's skill development and commercialisation of research for the benefit of the university, as well as the community and economy as a whole.

The research process should be systematically planned and managed as a project. Both the university and researchers should recognise their responsibility to conduct and disseminate research results in an honest and ethical manner and to contribute to the wider body of knowledge.

In creating and sustaining a culture that supports research, universities should look at the doctoral education concept within a human resource development framework.

EPILOGUE

So, what is doctoral education about?[15]

LAETUS O.K. LATEGAN

Since my own graduation as *Doctor Philosophiae* I have continued to think about this one, three-letter abbreviation: *PhD*. I cannot claim that I have a definite final answer yet to the exact meaning of L.O.K. Lategan, *PhD*. But I can state that the doctorate is like wine – as time progresses, so also do one's knowledge and comprehension continue to grow. Over time (and another study) my view and appreciation of doctoral education have extended from an idealistic "ivory tower" perspective ("knowledge for the sake of knowledge") to an ecological understanding of growth, changing (value) systems and sustainability.

When I was recently asked to speak on doctoral education at the South African Technology Network's annual conference, I formulated five perspectives. By the time of writing this column, it had grown to seven. (Ask me next week – there might be ten by then! See, I have just proven my own ecological understanding!)

I had never thought of supervising a student as a teaching and learning activity. I thought this was reserved for undergraduate education only. It was only when I started to supervise students that I considered this option: it entails one-on-one teaching, so ... be well prepared! Challenge your student with probing questions. Be punctual with feedback. Educate the student in the history of the discipline. Be curious. Keep on asking questions.

This led to another question: How do we produce knowledge for our time? Was it different when I was a student? Marginally? Substantially? How do you deal with the instant availability and dissemination of knowledge via e-journals, open access

15 This is an updated version of a column published in Getting ahead published in *Mail and Guardian*, February 2015.

publication, the Internet and social media? Can we claim that we assist students to have epistemological access? Can they add new ideas to a debate?

My journey was not yet over. I started with questions such as: Is a doctorate in engineering the same as, say, a doctorate in art? Clearly it can't be, yet both are referred to as a PhD. It was then that I realised that one should acknowledge differentiation in the doctorate. Immediately I was reminded by Shakespeare's "What's in a name?" Name giving, we learned, is important. So, I engaged my students and colleagues on "Where is the D in the PhD?" Thanks to Trafford and Leshem's well-known book, I could ground it in their concept of "doctorateness." (*Stepping stones to achieving your doctorate*. 2008.) This qualification is different from any other study you ever undertook, their dictum reads.

The debate is not over (yet). When I first read Boyer I was excited by his explanation of scholarship. As I travelled internationally I saw doctoral students competing for a position to study with well-known professors. Often I watched those professors and students in action. Here was something special going on: "scholars in training." (No surprise that I am knocked out every time I listen to the numbers debate instead of hearing evidence of how the new doctors are already shaping our world.) Then another knock-out: My supervisors and mentors reminded me twenty years ago that the doctorate prepares one for the academic world. It is the license, they said. And academia is a jealous mistress. It demands all from you. "Ultimate commitment" was one of those pieces of jargon that I memorised but never understood. Perhaps now I do.

In looking back over all those years, I stand with a red face. I had forgotten what it was all about: *doctoral education*. Doctoral education means that you should keep on shifting your boundaries, acknowledging change and wanting to master more. This is perhaps the closest that I will get, for now, to what doctoral education is.

Final comment: an adventure not to be missed! Enrol ASAP!

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It is safe to say that all universities are positioning themselves to grow their postgraduate enrolment. This strategy is informed by national policy directives to become more research competitive, the demands by the knowledge society, the ranking position of a university, the link between postgraduate studies, research outputs, research culture and consequently research competitiveness. A reality is, however, that greater numbers of students will put considerable strain on human, financial and infrastructure resources. This will also challenge the way that postgraduate supervision is practised at universities. Apart from the well-known challenges around supervisors' and students' roles and responsibilities, methodological comprehension and writing skills, more attention should be given to creativity, innovation and entrepreneurship in the "postgraduate curriculum". Part of research education we should also focus on is scholarship, ethical practice, socio-economic development, responsible citizenship and nation building.

This book presents different perspectives of support of the doctoral education value chain. Themes such as the scope of doctoral education, planning and roll-out of the research project, student and supervisor responsibilities, publication writing, grant applications, the application of research results and research ethics and integrity are addressed.

This book forms part of one of the three pillars of postgraduate research, namely research capacity building. The other two pillars are policy and methodology, which are addressed in other publications.

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