Guide for Emerging Researchers

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Abstract— This research booklet was compiled to guide postgraduate students and emerging researchers through their research career development. The sections covered within the booklet aim to equip the reader with necessary tools needed to choose an area of innovative research, proposal writing, publishing in accredited journals, supervision of postgraduate students and measuring one's research impact. The content within the booklet has been written in a comprehensive and easy-to follow manner to ensure that reader is captivated from the onset till the end.

Keywords—Emerging researchers, research guideline, research ethics, writing research paper, writing proposal, measuring research impact.

I. INTRODUCTION

Research can be a daunting task for academic staff especially for those colleagues who have been recruited without prior experience in research and are still busy completing their postgraduate degrees. This category of researchers also called early career researchers often face a significant challenge in finding enough time to simultaneously manage teaching, research and administrative responsibilities. It has recently become part of my professional responsibilities to assist such colleagues with their academic research tasks. I have also in the past few years played coaching role for younger academic fellows around the country, giving motivational talks at workshops and lectures to pave the way toward research achievements. Although time has always been an issue for all the scholars, I have come to realize that for younger colleagues without prior experience in research or for early career researchers in general, the main challenges have been either the fear of the unknown or the lack of appropriate strategy to engage in research when there is minimal or no resources (funding and laboratory facilities, to name a few). It becomes therefore obvious that without adequate mentorship in any form, these colleagues will hardly make it in the field of research. The starting point will be to get adequate postgraduate qualifications that provide enough training in a specific field of research from research proposal writing to publication of journal articles. It is however not yet the case as many academic staff still struggle to complete their degrees after several years of registration. This is also confirmed by recent statistics in the reports published by the Department of Higher Education and Training (DHET) in

South Africa, according to these reports, there is concern regarding the percentage of academic staff who hold doctoral degrees. The DHET has therefore taken a big step to increase the number of academic staff who hold doctorates by introducing for example the university capacity development programme which will contribute among other to the support of staff who enroll for postgraduate studies.

As part of my continuous contribution to the university capacity development programme, I have decided to compile this research booklet which will assist many researchers in finding adequate strategy to shape their research career especially under the circumstances of limited resources, to acquire effective writing skills (proposals and publications), adopt an ethical approach at every stage of scientific inquiry and to contribute toward the creation of new knowledge and the development of the community..

II. THE PATH TO BECOMING AN ESTABLISHED RESEARCHER

A. ACQUIRE A SUITABLE QUALIFICATION

A four-year university undergraduate degree (Honours, BEng, BTech) that involves research methodology and research project as part of the curriculum is generally the minimum qualification required to carry out academic research at the starting position (e.g. research assistant); however, to have an independent position and be able to manage projects and supervise students, a masters degree is often ideal. It is however not enough to be competitive and progress in the field. In South Africa many institutions prefer to recruit PhD holders in positions involving research responsibilities, because they have acquired written communication skills during their training and have probably already published few journal articles, which give them the necessary knowledge and skills to supervise postgraduate students. For the staff who have been recruited without a PhD qualification, they are now required to register and complete their degree in a specific time which can be quite challenging given their teaching loads.

It is always important to acquire a qualification in the field of your research interest as this will give you an edge in addressing specific issues relevant for that field.

B. CHOOSE A RESEARCH AREA

Your choice of research area must be among the factors that will help you grow in that specific field; for examples, your personal interest (you must not choose something that you do not enjoy doing as you will be quickly discouraged to carry on), your short and long term goals, the opportunities, availability of fundings, the relevance to the society and/or industry and advancement of knowledge.

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C. 1.3. INTENSIVELY REVIEW LITERATURE AND PUBLISHED REVIEW PAPERS

As part of the process to identify a suitable research area, you must read a lot to have an idea of the amount of works that have been covered in that field as to see how technologies or concepts have evolved to be able to ascertain new problems or problems not sufficiently solved. From this literature coverage you can already generate specific projects and write review papers or book chapters that could be done without the need of research funds that you probably do not have at this stage. Such approach can quickly help make your impact as a researcher in the field and gain recognition by peers (e.g. citations and recommendations), but you can also obtain publication incentives that will help start laboratory works or sponsor some other research expenses.

D. ATTEND CONFERENCES AND ESTABLISH COLLABORATIONS

Attending conferences and listening to other people talks can make you think differently, giving you new ideas that can make you refine your existing concepts. Conferences are attended by peers and experts from all over the world, which is an opportunity to network and exchange contacts with people who are working on related projects as this could lead to future collaborations. It is also important to mention that your contribution (abstract or paper) is often published in a conference proceeding book. In South Africa, researchers often received an incentive for publishing a peer reviewed conference paper.

E. WRITE PROPOSALS TO SECURE RESEARCH FUNDS

As an academic who is expected to deliver in research. As a starting point, you should generate fundings to sponsor your research (e.g. consumables purchase, running expenses, capital/equipment expenses, students bursaries etc). One of the common way to secure funding is to write a grant proposal. This is a written document submitted to an organization to secure funding for a research project. To convince people to fund your project, you must clearly define the purpose of your research, the approach to consider in order to achieve your goals, your timeline must be feasible and the budget must be reasonable (this section is further discussed below).

F. SUPERVISE POSTGRADUATE STUDENTS

Once you have received funding(s), it is important to appoint postgraduate students who can work on your projects and receive adequate training during the completion of their degrees, while helping you to achieve your general goals and publish your findings. You have to select dedicated and disciplined students who will be willing to work according to your instructions in order to meet deadlines.

G. INNOVATE AND PUBLISH MORE PAPERS IN ACCREDITED JOURNALS

It is important to work on projects which can add value to the existing knowledge by developing projects based on novel ideas that will result in ground-breaking findings with commercial potentials and/or more publications in peer reviewed internationally applauded journals with high impact factors.

H. FIND A WAY TO COLLABORATE WITH THE INDUSTRY AND ENGAGE WITH THE COMMUNITIES

Collaborate with the industry and communities to better understand their challenges and together agree on projects and approaches to solve problems that can lead to mutual benefits.

I. BE RESPONSIVE TO ACADEMIC CITIZENSHIP

Academic citizenship involves internal as well as external activities that are additional to the normal teaching and research focus. For this account, the researcher may therefore be involved in community engagement, research activities and university-affiliated activities. Examples include but are not limited to reviewing academic papers and grants proposals, authoring teaching materials, organizing conferences, mentoring institutional colleagues and research students, representing the university in national and international organisations, leading research groups and/or committees, and engaging in public lectures or communications to disseminate expertise. Researchers must always be aware of the forms of contribution to the academic citizenship as these ensure the smooth and collegial operation of our institutions with consideration among other of the safety, dignity and inclusion of all members of the academic community; additionally academic citizenship contribution is part of the requirements for academic promotion in many institutions.

III. CONCEPTUALIZING A RESEARCH PROJECT (PROPOSAL WRITING)

A research proposal is a brief and coherent introduction of your project to an intended recipient. It summarises the question you want to answer through your research. It demonstrates your knowledge of the subject area and shows the methods you want to use to complete your research within a reasonable time.

A. PURPOSE OF RESEARCH PROPOSAL

In an academic sphere, postgraduate students are required to write a proposal to achieve the following:

a. To propose a research project that will result in a significant contribution to knowledge

b. To formulate a detailed plan of the project including methodological approach and theoretical framework.

c. To ensure that the proposed research is achievable within the required time and with the available resources.

d. To demonstrate that you have adequate expertise and experience to undertake the project.

B. WHY IS IT IMPORTANT TO WRITE A PROPOSAL?

Writing a research proposal will encourage you to clarify your objectives and key ideas. It will enable you to think about each stage of the research process so that you can develop a clear and detailed plan. It will also help you to foresee problems that you may encounter during your candidature and prompt you to think about how you will manage them when they arise.

C. STRUCTURE OF THE PROPOSAL

Introduction
Background
Statement of the research problem

Research aim(s)
Research objectives
Hypothesis
Research questions
Literature review
Research methods
Timeline
Anticipated outputs
References

D. MEANING OF PROPOSAL SECTIONS

k. Background

The research proposal background identifies and describes in a concise way the history and nature of a well-defined research problem with reference to the existing literature. The background information should indicate the root of the problem being studied, appropriate context of the problem in relation to theory, research, and /or practice, its scope, and the extent to which previous studies have successfully investigated the problem, noting, in particular, where gaps exist that your study attempts to address. Background information does not replace the literature review section of a research paper; it is intended to place the research problem in a proper context.

b. Statement of the research problem

The problem statement must be introduced by highlighting the recent development in the field of interest as well as the limitations or unachieved work that need further attention. This could be related to the gaps identified in the literature and the relevance of the study.

c. Research aim

It is the main goal to be achieved and is related to the topic; it is therefore important that the title is relevant, i.e. related to an existing problem to be addressed.

d. Research objectives

These could be considered as specific aims, which describe in a bit of details the different goals to be achieved by the study; not to be confused with action plans.

e. Hypothesis

Based on the scientific principles that are well defined, you must be in position to make predictions of expected findings from each formulated objective. Hypothesis generally help the reader or audience to perceive your research skill and subject knowledge and therefore evaluate your ability to carry out successfully the project.

f. Research questions

The research questions are used to name as precisely as possible what the study will attempt to find out. If well formulated, they will determine the various steps of your investigation (structuration of the research methodology).

g. Literature review

It is a critical and factual overview of the previously published works relevant for your project. It should serve the purpose of situating the current study within the body of the relevant literature and to provide context for the reader. If well written, a literature review must prove the following:

- That you are of the recent development in your field of study.
- That your work carries on from what has already been done or addresses the limitations of previous works.
- That your work is relevant (suitable in addressing gaps in the literature).
- That your potential findings will contribute in advancing knowledge in the research field.

h. Research methods

It is the operational design dealing with the techniques by which the entire research can be carried out. What technical approach is needed to achieve the objectives and what consumables and equipment are needed.

- Discuss the acquisition of resources and suppliers.
- Outline the technologies to be used for the preparation or fabrication of products or equipment.
- Identify the parameters to be investigated as well as the levels to be considered.
- Briefly describe the processes to be used for the investigation of parameters.
- Briefly discuss the data analyses approach that will ensure the integrity of results.

i. Timeline

You can make use of Gant Chart to outline the various stages and corresponding timelines for developing and implementing the research, including writing up your thesis.

j. Anticipated outputs

List the various research outputs you will be likely to generate as you carry out the investigation.

k. Bibliography

List the references used in the proposal with consideration of the appropriate referencing style.

IV. ETHICAL CLEARANCES

A scientist needs to develop a strong sense of ethical responsibility to apply at every stage of scientific inquiry [1].

Research ethics is a subset of research integrity. Research integrity is seriously considered by academic institutions which have in most cases "research integrity offices" responsible of ensuring that researchers abide ethics principles.

A. CONTEXT OF RESEARCH INTEGRITY

Active adherence to ethical principles and professional standards essential for responsible practice of research.

Commitment to intellectual honesty and personal responsibility for one's actions and to a range of practices characterizing responsible conduct of research.

Researchers should consider research integrity as an aspect of moral character and experience.

Honesty is central to the relationship between the researcher and other interested parties.

Researchers can effectively contribute to knowledge if they ensure that:

- They function as a body to create a climate that promotes confidence and trust in research findings.
- Encourages free and open exchange of research materials

and new ideas.
  - Upholds personal and institutional accountability.
  - Acknowledges and respects the intellectual contributions of others.

B. ASPECTS OF RESEARCH INTEGRITY
  - Authorship
  - Peer review
  - Collaborative research
  - Plagiarism
  - Conflict of interest
  - Research involving humans and animals
  - Data management
  - Research misconduct
  - Financial responsibility
  - Environmental/social dimensions of research

V. SUPERVISION STRATEGY

In a supervisory relationship, a number of diverse supervisory approaches can be adopted by the supervisor:

There are four preferred operating approaches to postgraduate supervision; namely: - Laissez-faire, - Directional; - Contractual; - Pastoral [2].

A. Laissez-faire approach

The laissez-faire approach is a supervisory approach where the supervisor plays a minimal role in the research project.

B. Directional approach

A directional approach is a close monitoring supervisory approach. Directive supervision is essential when the student needs more guidance and close monitoring from the supervisor [2].

C. Contractual approach

The contractual approach is a consultative form of supervision where the supervisor provides both direction and support [2].

D. Pastoral approach

The pastoral approach is a supervisory approach where the supervisor provides emotional support to the student in addition to the academic support [3].

However, a model that aligns the supervisor and students on establishing relationship remains elusive [4]. This is due to numerous predictor variables, including age, prior educational background, gender, attendance status, intellectual environment, and funding as well as expectation [5, 6].

VI. WRITING A RESEARCH PAPER

A. TYPE OF PAPER (RESEARCH OR REVIEW)

Whether you choose to write a research paper or a review paper, your approach toward the preparation or the drafting of the paper will vary. The difference between the two is that a research paper is a primary source, meaning that it is based on original work by the author(s) who generate the data based on a well-designed investigation process and then present the findings in the for of "results and discussion" including original figures and tables. While the review paper is based on secondary source as the information is obtained from previously published work as the author(s) presents an overview of the topic's current state of understanding and then proceeds to a critical analysis of the reported findings to ascertain the satisfactory coverage of the initial problem(s) in the field to therefore open debate on prospective studies. Writing a review paper often requires a certain of knowledge and experience in a given field as well as a critical writing skill; there is a tendency of postgraduate students to often convert the literature review section of their thesis into review paper/book chapter; although this is encouraged, it should be done with the coordination of an expert in the field such as the supervisor.

B. SOURCE OF INFORMATION (LITERATURE OR DATA TO BE GENERATED)

The source of information for the research paper is the data generated from experimental work or any other original investigation; while for the review paper, information are obtained from previously published research work, but this should be done methodically to avoid plagiarism and the author(s) must consider diversified sourced to clearly provide a substantial state of of understanding regarding the topic at hand.

C. CONSIDERATIONS: NOVELTY OF THE IDEA OR REVIEW NOT YET COVERED

Avoid to reinvent the wheel; it is very important for all researchers to invest time in reading as much papers as possible to identify the gap in the literature before deciding on the topic to be covered in their study. There should be a problem to solve or the need to provide critical analysis of the literature on a specific topic in the case of research paper or review paper, respectively.

D. COLLECTION OF INFORMATION OR DATA

For research paper, prior reading allows the researcher to be acquainted with the approach that have been used in the previous similar studies. Based on that a diagnostic of the preliminary arrangement needed will be established. The researcher can then design the experimental work based on the resources and time available. For primary sources, data collection research methods may consist of experiment, interview/focus group, survey, case study and/or observation; while for review paper, information must derive from extensive literature review to situate your research in an existing body of work or to establish the current state of understanding for a specific topic.

E. WRITING THE PAPER

Paper template (choose a journal)

In general with few exceptions, a research paper contains the following sections: authors and affiliations, title, abstract, keywords, main body (introduction, methods, results and discussion, and conclusion), authors contribution, competing interest, grant information, acknowledgements, references, figures and tables, and supplementary materials. There can be a

slight variation depending of the journal, but most of these sections should be expected in a research paper. It is therefore important to always check the author guidelines for the journal in which you want to publish your paper.

Attitude (discipline and hard work)

When planning to write a paper, one should always be discipline and ready to devote the effort required. The first step is to read previous related works in order to have a clear understanding of what has been done and what approach has been considered. This is very important not only to write your introduction section and design the experimental approach, but it also assures you of the problem needing solution, helping you to put your work in clear context that confirms its relevance. One should not wait when all the lab work is completed to start writing; it is good practice to write as we progress, not to forget anything, but also to have a fresh mind such as to accurately report the fact and effortlessly generates ideas that will enrich the quality of the paper.

The meaning and content of each section

Title: The title must clearly reflect the content of the paper and must be concise and specific.

Authors: Authors are those who have made a significant intellectual contribution to the paper. The order of authors on the paper varies depending of the academic field. However, for most of the disciplines the order of authors on the paper is based on the level contribution. The corresponding author is the one who submits the paper to the journal. There should preferably be an agreement between the authors from the start to establish the basis for the determination of the order on the paper.

Abstract: This section could also be considered as a summarized form of the paper where you briefly discussed the motivation, methodology, significant quantitative results as well as conclusion and prospects.

Keywords: Although it is requested by all the journals, authors must also keep in mind that these increase the visibility of their paper and they describe the content of the paper.
Main body

Introduction: This section gives a brief background of previous work done in the context of the study; in the last paragraph of this section the authors must clearly elucidate why the study is important and what are the main goals to be achieved by the study.

Methods: This section must clearly describe the various steps of the investigations as well as the supporting material or software that has enabled the process. The design, description and control strategy of bias or unwanted sources of variability in this section must ensure accuracy and consistency making possible that the work can be repeated others.

Results and discussion: In this section the findings are presented in the form of figures and/or tables supported by elaborated narrative of the observations. Then the substantiation of the findings could be done by comparing them to previous works or evidence by well-established scientific principles.

Conclusion: This section summarizes the findings and define their impact on the broad aspects of life; making some recommendations for future investigations.

Authors contribution: Specifying the contribution of each author, provides significant accountability for the researchers involved. Although it is not compulsory for all the journals to specify the authors contributions on the paper, some explicitly request for it, while for some it is part of the submission process. The authors contributions may include the following: conceptualization, methodology, formal analysis, investigation, funding acquisition, resources, software, project administration, supervision, validation, visualization, writing-original draft preparation and writing-review and editing.

Competing interest or conflict of interest: The authors are requested to declare any secondary interest such as financial interest that can influence the validity of the primary interest which is research

Grant information: This the declaration of any funding or research grants received during the process of investigation and paper writing.

Acknowledgements: In this section the authors acknowledge people or institutions who contributed to the research in various ways e.g. financial, infrastructural, minor intellectual contribution, laboratory assistance etc.

References: All the references cited in the text are listed in this section. The authors must refer to the author guidelines for a specific journal to read about the referencing style requested.

Figures and tables: These are used to represent the data obtained during the investigation. Use appropriate software to draw the figures and tables and ensure that their titles do not exceed 15 words. Where necessary, provide a legend that will explain the symbols used. If possible, avoid to use colour as this may involve excess cost for print; rather use grayscale. Examples of line art include graphs, diagrams, flow charts and phylogenetic trees. Please make sure that text is at least 8pt, the lines are thick enough to be clearly seen at the size the image will likely be displayed (between 75-150 mm width, which converts to one or two columns width, respectively), and that the font size and type is consistent between images. To use figures and tables from other published papers, you must request a copyright authorization from the publisher.

Supplementary materials: These are data that could support the findings in the paper but do not necessarily fit in the main manuscript and could therefore not be subjected to the review process although it could accessible to the readership in any form.

Formatting the paper

It is important to check the formatting requirement in the author guidelines of a specific journal before preparing the final draft for submission. Your paper may be rejected by the editor if this is not properly done.

E. COMMUNICATING THE PAPER

How and why to select a journal?

The first think to consider when selecting a journal is to check if it publishes papers in your discipline (the journal scope policy

must match your need); is the journal accredited (not a predatory journal), you can get the list of the DHET (Department of Higher Education and Training) approved journals from your institution research office; is it an open access (check the article processing charge "APC") or subscription journal (closed access); how frequent does it publish per year, how quick is the review process or the turnaround time (cycle time) which is the time from the receipt of the manuscript by the editor until a decision letter about the manuscript is sent to the author; what is the standard of the journal, in other words, what is its impact factor, read carefully the author guidelines and some of the papers published in the last two years by the journal; this will allow you to carefully gauge the level of your paper and estimate the chances for it to be accepted by the journal; check the values and estimates of the rejection rates.

Selection of reviewers

As a researcher, you must have a strategy to grow your pool of reviewers, because it is not often easy to randomly name a reviewer and he/she accepts to review your paper. One the of the way to acquire potential reviewers is to attend conference and network with people who are in the same field; you can also make use of your co-authors network to identify potential reviewers who are likely to accept your invitation. When the avenue of your close or extended network is exhausted, you can make use of search tools such as Publons' reviewers connect or Taylor and Francis reviewers locator tool and others, you can check your references list to identify researchers who have published closely related papers recently, check your editorial board for reviewers recommendation. It also advised to mostly go for early career researchers as they are eager to build their experiences in reviewing articles and will therefore be likely to accept your invitation as reviewers.

F. HANDLING OF REVIEWERS' FEEDBACK

Accepted with changes (how to answer to reviewers' concerns?)

Carefully go through the reviewers' comments, address relevant comments satisfactorily, do not be afraid to disagree with unfunded or erroneous comments (however you have to politely provide an argument of why you think the reviewer has misinterpreted your manuscript). If you are unclear with reviewers' comments, do not hesitate to contact the editor for advice. When answering to the reviewers' comments, begging by thanking them for constructive comments that have positively enriched your new draft, clearly mention that you have addressed the comments they raised and provide the answer below each and every comment in different colour (e.g. blue or red).

Rejected (how to consider reviewers comments for improvement and what journal to choose next?)

If your paper is rejected, it is not the end of your career; get the most out of the worse. Carefully read the comments and identify relevant comments (these are funded or constructive comments) that you can use to improve your paper. Although to properly address some of these comments you may have to go back to the

lab, you are advised not to try and find the shortcut, do the right think in ensuring that your next draft is considerably improved. To resubmit your manuscript, you do not necessarily have to choose a journal of lower standard to the previous because it was rejected. If you honestly feel that your paper has been substantially improved you can even choose this time to submit your paper to a journal of higher impact factor. Sometimes, among the reason of rejection it was pointed out that you did not submit to the right journal based on the scope; make sure this time that you carefully read the author guidelines and ensure that the journal scope policy match the content of your manuscript before you submit.

G. ETHICAL ISSUES

As a researcher it is important to abide to publication ethics to promote the advancement of science and gain the respect of peers. As part of the Elsevier Ethics Toolkit, the following concepts have been considered as part of the research and publication misconduct:

Authorship: Authorship criteria must be discussed between the contributors before the start of the research, and the agreement must be respected when drafting the manuscript to avoid any potential conflict.

Competing interest: All interests and relationships that could be seen as influencing your findings must be declared in the appropriate section of the manuscript.

Plagiarism: Plagiarism is defined as the deliberate use of someone else's previously published work in one's own manuscript without consent, credit or acknowledgement. Plagiarism takes different forms including literal copying, substantial copying, paraphrasing, and text recycling. Most of the publishers recommend that the total similarities in a manuscript must be less than 20% while the similarities to a single source must be less than 3%. Manuscripts to be submitted to a journal must be thoroughly check for the level of similarities and edited accordingly prior to submission.

Submission fraud: This refers among others to the submission of the manuscript to at least two journals concurrently, having already published the entire work or part of it (salami slicing) or excessive citation of your own work.

Research fraud: There are two major forms of research fraud in research and scientific publishing which include fabrication and falsification.

Copyright issue: Reproducing someone else's material, figures or tables without written permission.

VII. PREDATORY JOURNALS

There are many definitions to predatory publishers, but one important violation of publishing ethics they have in common is that the review process is bias or non-existent. Few reported definitions are provided here below:

According to nature, predatory journals and publishers are "entities that prioritize self-interest at the expense of scholarship and are characterized by false or misleading information, deviation from best editorial and publication practices, a lack of transparency, and/or the use of aggressive and indiscriminate

solicitation practices.

According to Elmore and Weston [7], predatory journals are "also called fraudulent, deceptive, or pseudo-journals – are publications that claim to be legitimate scholarly journals, but misrepresent their publishing practices. Some common forms of predatory publishing practices include falsely claiming to provide peer review, hiding information about Article Processing Charges (APCs), misrepresenting members of the journal's editorial board, and other violations of copyright or scholarly ethics".

According to the Iowa State University's library, the predatory journal have the following common characteristics:

a. Their primary goal is to make money (i.e. there will be processing fees)

b. They do not care about the quality of the work published (i.e. no or little editing or peer-review)

c. They make false claims or promises (i.e. claims of impact factors and indexing).

d. They engage in unethical business practices (i.e. not as advertised).

e. They fail to follow accepted standards or best practices of scholarly publishing (various).

It is also important to mention that predatory publishing can also downgrade or dilute your research impact which often has a negative impact on your promotion, NRF rating and grants application. It is therefore advisable to avoid publishing in predatory journals.

VIII. Measuring Your Research Impact

The impact of a researcher is often measured based on a number of criteria such as the quantity of published research outputs as well as the number of time they have been cited. Some of the main criteria include the following:

a. The number of works published.

b. The total number of citations received.

c. The average number of citations per work published.

d. The number of significant works published.

e. The number of citations received by the most frequently-cited works.

H-index: The H-index is the most used author metric which was originally proposed by Hirsch [8]. It quantifies research output by measuring author productivity and impact. It is used as a research metric by Web of Science and Google Scholar. According to Hirsch [8], the H-index provide "an estimate of the importance, significance, and broad impact of a scientist's cumulative research contributions." The H-index can be calculated as follows:

A H-index of X represents the number of paper (X) that have received at least X citations.

e.g. A scientist with an H-index of 23 has published 23 papers that have received at least 23 citations.

I10-index: It is the number of publication with at least 10 citations. It is was created and is used exclusively by Google Scholar.

G-index: It is used to quantify publication in science based on

publication record; according to Egghe [9], the g-index measures the global citations performance of a set of articles and it is defined as the unique largest number such as the g articles received all together at least g2 citations.

The g-index is mathematically expressed as follows based on the general Lotkaian theory.

$g=((\alpha-1)/(\alpha-2))^{\wedge}((\alpha-1)/\alpha)\ T^{\wedge}(1/\alpha)$

Where $\alpha>2$ is the Lotkaian exponent and T denotes the total number of sources.

The g-index could be an important metric for early career research as apart from giving credit to highly-cited paper, it also gives credit to lowly-cited or non-cited papers.

ORCID or Open Research Contributor Identifier: It is a digital identifier that helps to uniquely identify those who participate in research, scholarship and innovation. In other words it helps researchers to showcase their professional activities; it is however not an author metric.

Impact factor: The journal impact factor is used as an indicator of the importance of a journal in its field [10]. It is a measure of the frequency with which the average article in a journal has been cited in a specific year. It encourages publishers to focus mainly of the quality (that can be cited by peers) of papers than the quantity. The JIF is calculated annually by the Institute for Scientific Information (ISI). The impact factor of a journal is updated every year and is therefore likely to change.

Example of calculation of journal impact factor.

JIF 2020 = Number of article published in 2018-2019/2020 citations to articles published in 2018-2019

Each journal may be associated with several subject areas and it is likely that the journal will have a different level of impact within each of these subject areas.

Each subject category of journals is divided into four quartiles: Q1, Q2, Q3 and Q4. Q1 is occupied by the top 25% of journals in the list; Q2 is occupied by journals in the 25 to 50% group; Q3 is occupied by journals in the 50 to 75% group and Q4 is occupied by journals in the 75 to 100% group. The most prestigious journals within a subject area are those which occupy the first quartile, Q1.

How to track your impact

Web of science: Authors can set up citation alerts with web of science and will receive an email every time the resource concerned is cited.

Scopus citation index: Scopus is among the leading database for citations and journal ranking statistics. According to the scopus website, it "combines a comprehensive, expertly curated abstract and citation database with enriched data and linked scholarly literature across a wide variety of disciplines". It provides access to reliable data, metrics and analytical tools (https://www.elsevier.com/solutions/scopus).

Google scholar citations: Google scholar citation is easy to set up when you have a google account. This database does not only tracks academic articles, it also tracks theses, book and other documents linked to provide author's citation metrics in

the form of H-index and i10-index.

IX. APPLIED AND INNOVATIVE RESEARCH (RESEARCH PARTNERSHIPS)

As a researcher one must always keep in mind that one of the ultimate goal of our researcher is to be relevant in our community or country; therefore we must strive toward developing and implementing projects that will have practical economic, social and environmental impacts in our country. To achieve this we have to work in partnership with the community, the industry and ensure that we develop innovative ideas that will eventually result in technologies that can solve societal challenges or have commercial potentials.

Community engagement

This entails working in collaboration (everyone who is affected by an issue that impacts their community should be in the position to contribute into the research project aiming to find solutions to the challenge at hand) with the community in identifying the problems impacting them, conventionalizing the research project and investigations, as well as decisions toward the deployment of the developed technology to ensure that it is broadly accepted.

Industry partnership

Researchers in universities can collaborate with the industry to address the challenges in the industries and in the society. Such collaboration can result to ground-breaking research and innovation that solves more complex problems and contribute to the training of students who are future workforce. Industries – universities partnerships generate more resources to undertake research and support postgraduate students.

X. DHET RESEARCH OUTPUT UNIT (ROU)

Research productivity at public higher education institutions is encouraged by the Department of Higher Education and Training (DHET) by rewarding quality and approved research outputs. To ensure that research integrity and ethics is maintained, the DHET has a rigorous control system that verifies the credibility of journals and publishers, as well as the robustness of the peer review system prior to consideration of a research output. This is a policy adopted to discouraged irrational pursuit of quantity at the expense of quality, often leading to some researchers publishing in predatory journals. The DHET has made it clear that it promotes the "importance of academic publication as a driver of knowledge dissemination rather than accruing incentive funding".

XI. WEIGHT OF RESEARCH OUTPUTS

According to the report on the evaluation of the 2019 universities' research output published by the DHET in March 2021, research outputs published by DHET approved journals or publishers weight as follows:

a. A journal article has a weighing of 1 unit.

b. An edited book has a weighing of up to 10 units (more than 300 pages).

c. A book chapter has a weighing of 1 unit.

d. A conference proceedings paper has a weighing of 0.5 unit.

e. Doctoral graduate has a weighing of 3 units.

f. A research masters graduate has a weighing of 1 unit.

It should be noted that the weighing can vary from one year to another, as it has been observed in the past years.

When a research output has more than one author, the number of unit must be equally shared among all of the authors.

APPENDIX

Appendixes, if needed, appear before the acknowledgment.

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