COMPARISON OF FACULTY'S RESEARCH PRODUCTIVITY (*H*-INDEX AND CITATION INDEX) IN AFRICA

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ABSTRACT: *The study aimed at comparative determination of faculty's research productivity in Africa, using h-index and citation index from Google Scholar database. The h-index and citation index are the most authentic, valid and reliable measures of faculty's research productivity worldwide. Eight research questions were answered with descriptive statistics, and eight corresponding null hypotheses were tested with Analysis of Variance (ANOVA) and One-sample **t** test at 0.05 alpha. A disproportional stratified sample of 3000 faculty in Africa was drawn, cutting across fifteen universities from the five African regions. Comparative causal-effect Ex Post Facto research design guided the work. Google Scholar citation database that has been unquestionably judged as the most dependable, accurate and e-visible database served as the source of data for measuring the faculty's research productivity. Results primarily showed that African h-index and citation index are significantly lower than the world averages of 17.50 and 971, respectively. Also, the h-index and citation index of the University of Cape Town, University of Pretoria and Cairo University are significantly greater than those of other African universities. Southern Africa and North Africa each has h-index and citation index that are significantly higher than those in the other African regions. South Africa and Egypt have h-index and citation index that are not only greater significantly than those of other African countries, but also significantly higher than the world averages. Recommendations were accordingly made for a possible acceleration of the research productivity of the faculty in the continent.*

KEYWORDS: Research productivity, *h*-index, Citation index, African universities, Faculty, Google Scholar, University rankings, Google Scholar Profile.

INTRODUCTION

This research comparatively investigated the research productivity of scholars in African universities as exceptionally measured by their *h-index* and *citation index*. While *h-index* is the best numerical representation of the productivity and impact of a scientist strictly based on his publications and patents, *citation index* is the total number of citations that a scientist's publications have attracted as the second-best representation of his research productivity. Citation index and h-index are the best indexes that depict research influence by clearly showing each researcher's role as

well as each university's role in the creation and dissemination of novel ideas and new knowledge.

Citation index and h-index are the best ways of measuring research productivity by precisely capturing the average number of times that a scholar's published works and the research works published by a university, country, region or continent are cited by scholars internationally. The two indexes (h-index and citation index) exceptionally demonstrate how much each faculty is contributing to the totality of human knowledge. The two indexes excellently reveal whose research has distinctly stood out by been frequently picked up and built upon by other scholars and used in the industry. Of greatest importance is the fact that h-index and citation index extraordinarily represent the magnitude to which each researcher's works have been shared around the global scholarly community for expansion of the boundaries of human understanding, irrespective of the discipline. A scientist's reputation for research excellence can best be determined based on the extent to which his h-index and citation index overwhelmingly exceed those of other scholars. The more the number of scholars with unprecedented h-index and citation index in a university, the more prestigious the institution is publicly perceived to be in terms of its teaching-learning environment (Kpolovie, 2014), and the higher the research income that the university attracts. Research productivity is the core determinant of university rankings across the world.

When the h-index and citation index of all the scholars per university are added, the two indexes, more than every other thing, accurately portray the extent to which each university is contributing to the sum of human knowledge. Citation index and h-index of all the scholars in each university tell us the universities that have individually stood out by having her disseminated research findings picked up frequently and built upon by scholars globally. Most crucially, h-index and citation index of each university tell us how well units of inventions and knowledge discovered by each university have been shared around the international scholarly community for expansion of the frontiers of collective human knowledge for prevention of adversities and for problem resolutions. Each university's reputation for research excellence can best be determined based on the extent to which the university's research productivity (h-index and citation index) overwhelmingly exceed those of other competing universities and colleges. The perceived prestige of each university is mostly a function of the number of faculties with astonishing high h-index and citation index. These could equally be said of countries when the h-index of scientists in each country are added and when the citation index of scholars per country are added (Kpolovie and Obilor, 2013b). Continents can as well be compared on the basis of their research influence or research productivity with the use of h-index and citation index as the measuring scales (Kpolovie, Ewansiha & Esara, 2017; Kpolovie, Oshodi & Iwuchukwu, 2016). In the current investigation, the research productivity as exceptionally measured with all accuracy by h-index and citation index of the scholars in African universities, African countries, and

African regions are compared; and are each compared with the world's parameters, the average world h-index and citation index.

"No nation or state can rise above the volume of its research. The developed nations attained and are sustaining their enviable status through enormous investment in research" (Kpolovie, 2015a, 7). The industrialization of a nation or continent is dependent on the prowess of universities' ability to take the lead in the processes of knowledge discovery. Universities are saddled with the responsibility of discovering new ideas and modifying old ones to sooth the changing trends of life. Universities are considered as modern entrepreneur engine and generator of knowledge through research (Dorgu & Kpolovie, 2019). The importance of research cannot be overemphasized in a university environment. International publication of research findings by each scientist is the most significant indicator of the faculty's productivity as well as the productivity of his affiliated university. The volume of research publications online in any field of specialization provides current information for growth, progress, development and improvement in the society. Research publications in the World Wide Web are also the most decisive yardstick for ranking universities among the best within a country, continent and the world at large (Ololube, Kpolovie, & Makewa, 2015). It is internationally published research works that increase the prestige of the faculty and his status to the rank of a professor. No one can indeed be said to be a professor without a series of internationally published works that are easily accessible online. A faculty can only be rightly said to have professed units of knowledge that he discovered when such knowledge has been published electronically for global use at will. Publication of research works motivates hard work and fills in the blanks of previous research works and creates a course of action for future investigations. Scientific or research accomplishment is determined by the number of publications in internationally available refereed journals and conference proceedings of repute.

Quality research, therefore, exposes faculty to new information and sharing of socio-cultural ideas with others. During the process of research, a faculty has the opportunity to move out of his environment to seek for information and collect relevant data. It is even more so with this era of technology that with the presence of the internet, information can be collected from anywhere in the world from the comfort of one's abode. A faculty's quality research contributes to genuine indigenous and sustainable development (Bassey, Akuegwu, Udida & Udey, 2007). Research consists of the creation of knowledge and new approaches to identifying and explaining phenomena, critical evaluation of previous knowledge and applying knowledge and experience to clarify and describe social and professional needs. Kpolovie (2016; and 2010) described research as the logical, systematic and objective collection, analysis, synthesis, evaluation and recording of accurate and controlled observations to aid informed generalizations, the establishment of principles and theories that foster description, explanation, prediction and control of natural occurrence to meet man's needs. Knowledge gained through research is

always objective and scientific. Research-based knowledge is always logical, rational and experiential. Research is an organized effort to solve complex problems that are begging for solutions. Research influences the main body of knowledge, and this, in turn, influences education and provides further services to the public.

Research Productivity

Research productivity is the quantification of the cumulative impact, relevance, efficiency and throughput of a researcher's scientific work as validly and reliably measured with ***h*-index**. Kpolovie (2018) posited that:

h-index is a metric that uses a single number to best measure a scientist's professional productivity as depicted by how many of the scientist's *k* publications that have been cited up to *k* times by international publications of other scientists. The *h-index* is the best numerical representation of the impact and productivity of a researcher/scientist, strictly based on the researcher's publications and patents, rather than the impact factor of the journals in which the papers were published.

Literally, research productivity is derived from two words 'research' and 'productivity'. While research deals with very careful, observant, and vigilant study or investigation of phenomena, particularly to search and find out new knowledge, information and facts; productivity is concerned with production or output, produced within a given duration of time. With reference to higher education, research productivity is an index which best depicts the publications of papers in professional journals, in form of journal articles, book chapters, or books as well as the presentation of research papers in conference proceedings that are indispensably cited and acknowledged by other scientists' publications in globally accessible papers and books.

Determining the research productivity of the university faculty members is of greater interest to the academicians trying to preserve their academic status and to the university management to provide a smooth and progressive climate to the academic staff (Dorgu & Kpolovie, 2019). In the academic environment, the productivity of academic personnel is measured based on the research productiveness of such personnel.

Research productivity and research activity are interrelated. Research means to conduct a research, collecting data, and analyzing the data; productivity means writing, reading and publication of the research reports in professional referred journals, displaying on the web or to make it known to the global audience through any other means, in shape of books or making its presentation on the television or radio. According to Creswell (2008) and Tafreshi, Imani and Ghashlag (2013), research productivity includes research publications in professional journals and in conference proceedings, writing a book or book chapter, gathering and analyzing original evidence, working with students on dissertations and class projects,

obtaining research grants, carrying out editorial duties, obtaining patents and licenses, writing of monographs, developing experimental designs, producing works of an artistic or creative nature, engaging in public debates and commentaries. Research project is more than collection of information; it requires planning ahead, which sources to consult, what kinds of notes to take, and how to put it all together into an effective paper, and disseminating it globally.

Research productivity is the quality, and often the quantity of research published internationally as textbooks, or chapters in books, journal articles, conference/workshop proceedings, occasional papers, monographs, edited books, bibliographies, abstracts, and indexes published (Okanedo, Popoola, Emmanuel & Bamigboye, 2015). Measuring research productivity is a complex task, and productivity is measured in different ways depending on the granularity of the situation, the discipline, the type of institution, and the maturity of the field. It was in accordance with this view that Tafreshi, Imani & Ghashlag, (2013) stated:

Most decision-makers consider research works published by academic staff as the primary signal for their quality. Research activities are regarded as one of the essential jobs of academic staff. These activities lead to production of new knowledge and science and is realized through research (including research report and preparation of papers) and books. Thus, research consists of the production of knowledge, creation of new approaches to identify and explain phenomena, critical evaluation of previous knowledge and applying knowledge and experience to clarify and describe social and professional needs. Research influences the main body of knowledge, and this, in turn, affects education and providing further public services and in general research gives credit to the concept of a researcher.

Excellent and most profitable decisions in the higher education industry to all the stakeholders in today's world and in the future decades can best be made on the basis of research productivity indicators (Ololube, Emejuru, Kpolovie, Amaele & Uzorka, 20120. Credible knowledge is necessary for virtually every decision we make and reliable information and metrics are the basis for every good science policy and strategic decision making in the world today (Ololube & Kpolovie, 2012; Ololube, Egbezor & Kpolovie, 2008; Bakuwa, 2014; Ololube, Amaele, Kpolovie, Onyekwere & Elechi, 2012). According to Costas and Bordons (2007), policymakers, science managers, and funding agencies use citation indicators to support research assessment decisions. "Citation impact indicators can even determine the level of research and development of a particular country. This emphasizes the importance of citation impact indicators for African countries. Citation impact indicators are also used to reward individuals for their distinguished contribution to the knowledge base. Nobel Prize Organizations, for example, select recipients of prizes on the basis of their remarkable achievements in literature, physics, chemistry and physiology or medicine. This decision is mainly based on the number of citations in high impact journals of their ground-breaking research in respective fields."

Yusuf (2012) noted that the saying "publish or perish" is quite popular in the university setting. According to him, this phrase underscores the importance attached to research in any university. It is the main index of a faculty's quality and the determinant of advancement. Research is a systematic attempt to search and investigate finding solutions to problems or questions in order to increase knowledge. It is targeted at describing events, predicting events or controlling events. Research provides opportunities for collaboration and networking among scholars throughout the world. National and international dimensions of research issues can, therefore, be studied as they can allow for communication with peers and experts around the world. Through collaborative knowledge building, studies can spotlight a trans-national trend. As significant as research publication is in the university, difficulties are being encountered by academic staff. The simple counting of published and unpublished research outcomes does not allow any comment upon the quality of work. For examination of quality, peer review rating and citation analysis have emerged as relatively new tools to assess the value of the contributions of research to the discipline (Harzing, 2011).

With the advent of the internet, a new way of measuring research productivity with most exceptional accuracy and precision has emerged, and it has opened up new lines of opportunities for researchers to reach out to the wider world in presenting their profiles and making their works more visible (Lateef, Ogunkunle & Adigun, 2016,). According to them the internet "is the genesis of e-visibility".

When Google Scholar (GS) was launched in November 2008, it provided the opportunity for faculties to access diverse academic information freely on the web, breaking the exclusive control of other sites that charge subscription fee for information. With that initial success of Google Scholar in making multidisciplinary academic information available, the Google Scholar Citation (GSC) was launched in April 2012 (Jacso in Lateef et-al, 2016). This afforded scholars the opportunity to create an editable personal profile and made the process easy for evaluating citation metrics.

"Google Scholar searches for scholarly publications from all disciplines across the world for scholarly research" (Dhamdhere, 2018). With the use of Google Scholar, a faculty is exposed to related works, citations, authors and publications, location of a complete document from the web, keep up with recent developments in any area of research, including patents or citations options, keeping track of citations, getting graph citations over time, checking who is citing a publication and creating a public author profile free of charge. Google Scholar also collates and computes several citation metrics like h-index, i10-index and also ranks the documents the way researchers do, provide details of each document, where it was published, how often and how recently it has been cited in other scholarly literature (Dhamdhere, 2018).

Faculty's Google Scholar Profile

Individual faculty or researcher can create a Google Scholar account using his G-mail. This can be authenticated and made public by adding authentic institutional email ID. After adding personal details and profile picture, a research scholar is able to add his or her authored publications directly from the list that appears or manually. A researcher can select and input multiple groups if he has written articles under different names, with diverse groups of colleagues, or in different journals. After that, all his publications available online appear in his created Google Scholar Profile. Each faculty in every university, college, other tertiary institutions of learning, and every scientist in all research institutions is necessarily required to create his Google scholar profile and make it public (Kpolovie and Onoshsgbegbe, 2017; Kpolovie, 2018).

The h-Index

The **h-index** was introduced by Jorge Hirsch, a physicist in August 2005, at the University of California, San Diego, USA. It brought about a new and the most accurate, valid, reliable and precise gauge for measuring the research productivity of scholars (Bornmann & Daniel, 2007a; 2007b; 2009; Bornmann, Daniel & Mutz, 2008c; Hirsch, 2005). The purpose was to provide an option to other bibliometric indicators such as the number of publications, the number of citations, total number of citations and the age average of an article (Hirsch, 2007).

"I propose the index h, defined as the number of papers with citation number $\geq h$, as a useful index to characterize the scientific output of a researcher… A scientist has index h if h of his or her N_p papers have at least h citations each and the other $(N_p - h)$ papers have $\leq h$ citations each." (Hirsch, 2005, p.16569). H-index measures the scientific productivity and impact of a scholar's research. A scholar's *h index* of **7** means that seven of his published papers have each been cited at least seven times by other publications that are readily available in the ocean of knowledge, the World Wide Web. "The *h-index* is a metric that uses a single number to best measure a scientist's professional productivity as depicted by how many of the scientist's publications that have been cited up to *h* times by international publications of other scientists" (Kpolovie, 2018). "The *h-index* describes the number of research publications of a scientist that are highly impactful, irrespective of the journals in which they were published" (Becker Guides, 2016, Kpolovie, 2018).

According to Kpolovie (2018) "only the total number of papers published and the total number of citations the publications received are required for the determination of a researcher's h-index. This is simply because h-index is a researcher's k publications that have each been cited at least k times by other publications that are readily available online. If the total number of publications by scientist A is 10, the total citations made of his publications is 40, and only 4 of his publications have each been cited up to 4 times; the h-index of scientist A is 4. The *h-index* of scientist A is illustrated using Figure 1 below. Given that the researcher A has published 12

articles and each has been cited as follows: A1 (15), A2 (7), A3 (5), A4 (4), A5 (3), A6 (2), A7 (1), A8 (1), A9 (1), A10 (1). The *h-index* is the position at which the number of citations is greater or equal to that rank, and the rest citations are each less than the rank. Therefore, in the case of researcher A in Figure 1, the **h-index** is **4**. That is, each of his first three most cited papers has been cited more than four times (15, 7 and 5, respectively), while his fourth most cited article has been cited 4 times. Since four of scientist A's published articles have each been cited at least four times, his h-index is 4 as illustrated in Figure 1.
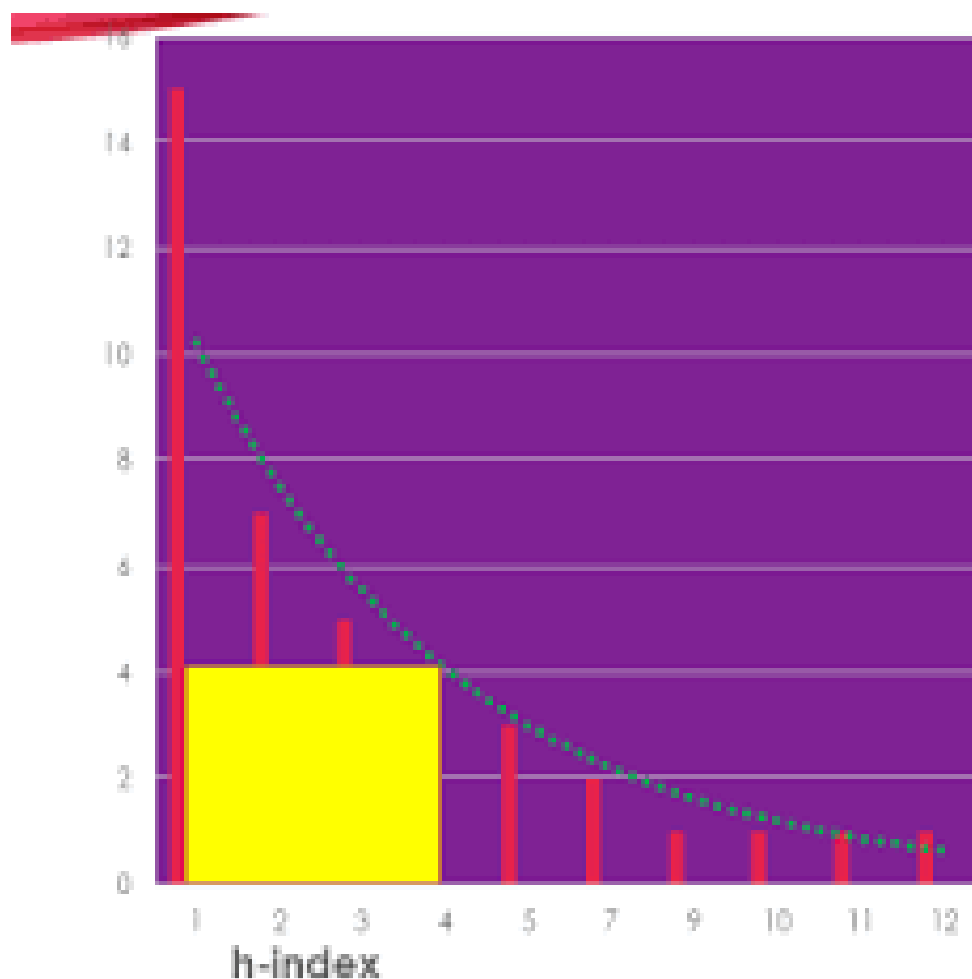

Figure 1: The *h-index* of scientist A [**Source** – Kpolovie P J, 2018 p11 Multiple prediction of research productivity. *European Journal of Computer Science and Information Technology* Vol.6, No.5, pp.9-36, November 2018]

As significant as research publication is in the university, difficulties are being encountered by faculty in Africa in the area of the kind of journal an article can be published to attract maximum e-visibility. The measure of research productivity is dependent on the impact of each published work based on its bibliometric statistics.

This study is poised to investigating faculty's research productivity in Africa with a view to ascertaining their *h-index* and citation index and making comparison with the world average *h-index* and citation index.

Analyzing the 2015 list of 800 top scientists in Nigerian institutions that was published by the Ranking Web of Universities (Webometrics, 2015), Kpolovie (2015, 1) in a report that outlined the top 100 scientists on the list averred that:

Ranking of scientists on the basis of their research or academic productivity, otherwise referred to as h-index is the best encouragement that researchers in this country and perhaps in other countries as well could get. It is a sure evidence of recognition of the immeasurable efforts that researchers make to arrive at units of knowledge that could better the world. In the entertainment industry for instance, artists, actors and actresses are celebrated frequently. But scientists are never noticed. Academics for example that have embarked on extremely arduous and nerve-racking research and selflessly published their empirical findings are usually left without recognition of any form. The ranking of scientists as done by the Ranking Web of Universities (Webometrics) is indeed a great way of celebrating academics who have sacrificed everything to successfully execute research and disseminate the knowledge arrived at.

University Rankings on basis of Research Productivity
The rankings of universities globally by different ranking bodies is primarily based on research productivity of the faculty in each institution, and African universities perform very poorly in the rankings because little or no attention is paid to research productivity in Africa (Kpolovie and Obilor, 2013b), and partly because the governments in African countries invest too little in research and development (Kpolovie and Obilor, 2013c). Only one university (University of Cape Town) made the top 193 world universities in the 2020 Times Higher Education rankings, and this is the best-ever outing of African universities. Times Higher Education (THE) World University Rankings 2019 methodology (Times Higher Education, 2019), like the previous years, considers five indicators, each of which is directly or indirectly dependent on the faculty's h-index and citation index under the following headings and percentages for ranking of universities all over the world.

- *Teaching* (the learning environment) is accorded 30% that is made up of Reputation survey (15%), Staff-to-student ratio (4.5%), Doctorate-to-bachelor's ratio (2.25%), Doctorates-awarded-to-academic-staff ratio (6%), and Institutional income (2.25%).
- *Research* (volume, income and reputation) attracts 30% that is dependent on Reputation survey (18%), Research income (6%), and Research productivity (6%).

- *Citations* (research influence) is accorded 30% that is based strictly on the university's role in the generation and spreading of new knowledge and ideas as reflected by the faculty's h-index and citation index.
- *International outlook* (staff, students, research) attracts 7.5% that is composed of the Proportion of international students (2,5%), Proportion of international staff (2.5%), and International research collaboration (2.5%).
- *Industry income* (knowledge transfer) that attracts 2.5%.

No university in Africa made the top 197 world universities in the QS World University Rankings 2020 largely because in Africa, no attention is given to faculty's research productivity; while the six metrics that the rankings are anchored on are each tied directly or indirectly to faculty's research productivity (h-index and citation index) (QS World University Rankings, 2020). The six metrics are:

- *Academic Reputation* that attracts 40% which is primarily based on faculty's research quality and secondarily on teaching quality.
- *Employer Reputation* (10%) that is based on the universities from which employers sourced the most competent, innovative and effective graduates.
- *Faculty/Student Ratio* (20%) that is measured by the extent to which a university provides its students with substantially meaningful access to productive lecturers and tutors.
- *Citation per faculty* (20%) that depends on the normalized total number of citations received by all papers internationally published by an institution across 5-year period divided by the total number of faculty in the university.
- *International Faculty Ratio* cum *International Student Ratio*, accorded 5% each on basis of the university's ability to attract faculty and students from across the world.

For the same reason of insufficient attention to faculty's research productivity in Africa, no single university in Africa made the top 273 world universities in the rankings by the Ranking Web of Universities 2019 (Webometrics, 2019) as the four indicators of the ranks are mainly dependent on the research productivity of the faculty in each university. The indicators are Presence, Impact, Openness, and Excellence.

- *Presence* attracts 20%. It is measured by the total number of webpages hosted in the main Web domain of the university to reflect the contributions of everybody (faculty in particular) that are recognized by Google. It captures the commitment of scholars with their students.
- *Impact* is accorded 50%. It is measured by the quality of contents through virtual referendum regarding all the external links to the university Web domain, particularly those from each of the journals that the faculty's papers are published. It covers the institutional prestige, academic performance, the link visibility, popularity and number of functional back domains.

- *Openness* accounts for 15% that is determined by the university's efforts to set up institutional research repositories that are globally accessible round-the-clock for the faculty. It covers the number of rich files (e.g., pdf, doc, ppt, docx) published in dedicated websites based on the academic search engine – Google Scholar. It primarily considers recent internationally available publications within the past 5-year period by each faculty.
- *Excellence* receives 15% and is measured by the volume of academic papers published in internationally indexed and available journals. It is mainly dependent on the 10% most cited articles in the various fields.

The Ranking Web of Universities is indeed the largest academic rankings of higher education institutions that is fairly, freely, reliably, validly, and multidimensionally published twice a year (i.e., done in every six months) by the Cybermetrics Lab (Spanish National Research Council, CSIC) comprehensively about the global performance of each university in line with its presence, openness, excellence, and impact. These indicators collectively assess the research productivity of the university faculty as the totality of activities, output and relevance of the institution in the world's radical advancement.

The original aim of the Ranking is to promote academic web presence, supporting the **Open Access initiatives** for increasing significantly the transfer of scientific and cultural knowledge generated by the universities to the worldwide society. In order to achieve this objective, the publication of rankings is one of the most powerful and successful tools for starting and consolidating the processes of change in the academia, increasing the scholars' commitment and setting up badly needed long term strategies… In the second decade of the 21st century the Web is key for the future of all the university missions, as it is already the most important scholarly communication tool, the future channel for the off-campus distance learning, the open forum for the community engagement and the universal showcase for attracting talent, funding and resources (Webometrics, 2019a).

Statement of the problem
The faculty in African universities and the university authorities in Africa have too little or no attention at all to examination of research productivity as they are solely concerned with measurement of students' academic achievement (Kpolovie, 2016; Kpolovie, Joe & Okoto, 2014; Ololube, Umunadi & Kpolovie, 2014; Kpolovie, Ololube & Ekwebelem, 2011; Joe, Kpolovie, Osnwa & Iderima, 2014) to the total detriment of assessing the lecturers' academic productivity (Kpolovie & Lale, 2017; Kpolovie, Iderima & Ololube, 2014; Kpolovie & Ololube, 2013). Worse still, research productivity in African universities is largely mistaken for the grade point averages that the students graduate with (Kpolovie & Obilor, 2013a; Kpolovie & Awusaku, 2016). A lecturer's productivity is unfortunately assessed instead in terms of the scores that students get in the courses taught by him (Ololube, Amaele, Kpolovie & Egbezor, 2012; Ololube, Ajayi, Kpolovie & Usoro, 2012). There is,

therefore, an enormous knowledge gap that demands immediate filling, and the current investigation is structured to solve that great problem. Comparison of pure research productivity as validly and reliably measured with h-index and citation index among faculties and institutions across the world has fast become the best way for recognizing and celebrating researchers and their contributions. The problem of identifying the very best way to quantify the cumulative impact, relevance, and productivity of each researcher's scientific work in African universities is squarely addressed in this study. Citation index and h-index which are the best universal indexes for the purpose were used to measure the research productivity of academics across universities within Africa, and in comparison, with the world's average h-index and citation index.

Research Questions and Null Hypotheses
Specifically, eight research questions and corresponding null hypotheses guided the investigation.
What is the difference in the:
1. h-index of faculty among African universities?
2. h-index of faculty among the regions in Africa?
3. h-index of faculty in each African university and the world's average?
4. h-index of faculty in each African country and the world's average?
5. citation index of faculty among African universities?
6. citation index among the regions in Africa?
7. citation index of faculty in each African university and the average world citation index?
8. citation index of each African country and the average world citation index?

The following null hypotheses were tested at 0.05 alpha level.
1. The h-index of faculty in African universities do not significantly differ.
2. The h-index of faculty in African regions do not significantly vary.
3. The h-index of faculty in each African university and the average world h-index do not differ substantially.
4. The h-index of faculty in each African country and the world's average h-index do not vary significantly.
5. Significant difference does exist in citation index among faculty in African universities.
6. There is no significant regional difference in citation index of the faculty in Africa.
7. There is no significant difference in citation index of faculty in each African university and the world's parameter.
8. Significant difference does not exist between citation index of faculty in each African country and world's average.

METHODOLOGY

Quantitative research approach was adopted in this study to finding answers to the research questions raised, and hypotheses postulated. Quantitative research methods are methods that deal with numbers and anything that is measurable in a systematic way of investigating phenomena and their relationships. It is used to answer questions on relationships within continuous measurable variables with an intention to explain, predict and control some phenomena. The quantitative method typically begins with data collection based on a hypothesis or theory, and it is followed with the application of descriptive or inferential statistics. According to Kpolovie (2018a; 2017; 2016; 2011), it entails the gathering of numerical data and extremely precise statistical analysis to facilitate description, explanation, prediction and control of the phenomenon of interest. Comparative causal-effect Ex Post Facto research design was employed in this study. "It is a design that is used to cover investigations that are done retrospectively (after the effect has occurred) to identify probable cause-and-effect relationships between the variables under investigation' (Kpolovie, 2010). In this design, the researchers seek to empirically establish the causes or consequence of the already existing difference between or among non-randomized groups of individuals. It is a design that investigates the influence of independent variables that are categorically measured on a dependent variable that is continuous measured.

This study is carried out in African. Africa is the world's second largest and second most-populous continent (behind Asia in both categories). It has an area of about 30.3 million km2 (11.7 million square miles). Africa covers 6% of Earth's total surface area and 20% of its land area, with a population of 1.2 billion people leaving in it as at 2016, it accounts for about 16% of the world's human population.

An estimate of eight hundred and forty-three thousand, five hundred (843, 500) university teaching staff makes the population of this study. Disproportional stratified sampling was used to draw a sample of 3, 000 faculty, and 15 universities for the study. The sample consists of 600 faculty from each region, and 200 faculty from each university as shown in Table 1.

Table 1: Sampled regions, countries, universities, and number sample faculty

S/N0	Region	Country	University	Faculty
1	Southern Africa	South Africa	University of Cape Town	200
2	Southern Africa	South Africa	University of Pretoria	200
3	Southern Africa	Zimbabwe	University of Zimbabwe	200
4	North Africa	Egypt	Cairo University	200
5	North Africa	Morocco	Al Akhawayn University	200
6	North Africa	Tunisia	University of Tunis El Manar	200
7	East Africa	Ethiopia	Addis Ababa University	200
8	East Africa	Kenya	University of Nairobi	200
9	East Africa	Uganda	Makerere University	200
10	Central Africa	Zambia	University of Zambia	200
11	Central Africa	Cameroon	University Buea	200
12	Central Africa	Angola	Universidade Agostinho Neto,	200
13	West Africa	Nigeria	University of Ibadan	200
14	West Africa	Ghana	Kwame Nkurumah University of Science and Technology.	200
15	West Africa	Nigeria	University of Port Harcourt	200
Total				**3, 000**

Bibliometric statistics, **h-index** and **citation index**, of the sampled faculty from Google Scholar database were obtained for the investigation. Google Scholar citation database has been conclusively judged as the most dependable and accurate databases for measuring faculty's research productivity (Library Guides, 2017; Spicer, 2015; Google Scholar, 2019, Kpolovie 2018; Kpolovie & Onoshagbegbe, 2017). It has very high reliability and validity. Google Scholar is the world's largest abstract and citation database of peer-reviewed literature, scientific journals, books and conference proceedings. The data were briskly collected within three days to prevent downtime from affecting the validity and reliability of the observation. Data Collection Form designed by the researchers was used for entry of the data (each faculty's h-index and citation index) from the Google Scholar citation database.

The following procedure, as highlighted by Kpolovie & Onoshagbegbe (2017), were followed in obtaining information from Google Scholar.

I. "Switch on a system (laptop) to boot.
II. Connect an internet device (Wi-Fi, hotspot, modem, router, etc.) with secure network connectivity.
III. Click on browser and key, "www.scholar.google.com" into the address bar and enter.
IV. Google Scholar Search Engine appears.
V. Type in the name of the university (e.g., University of Cape Town The "User profiles for all faculties" will appears.
VI. Click the User profiles for each faculty, for instance, if Peter James Kpolovie has Google Scholar account, his complete citations index with the h-index automatically appears.

VII.   The statistics of each scholar is extracted and entered into the Data Collection Form for subsequent analysis.

The research questions were answered with mean and standard deviation. The null hypotheses were tested with Analysis of Variance (ANOVA) and One-Sample t-test at .05 alpha with the aid of IBM SPSS Statistics (Version 26).

RESULTS

The findings and interpretation of the study are presented in line with the research questions and hypotheses.

3.1 Research Question One

What is the difference in h-index of faculty among African universities?

Table 2: Mean and standard deviation of h-index of faculty in Africa Universities

Universities	N	Minimum	Maximum	Mean	Std. Deviation
University of Cape Town	200	8.00	126.00	32.80	15.66
University of Pretoria	200	6.00	90.00	23.69	12.20
University of Zimbabwe	200	1.00	61.00	4.28	6.21
Cairo University	200	7.00	124.00	21.16	11.83
Al Akhawayn University	200	1.00	29.00	9.59	8.94
UTE,TUNISIA	200	3.00	128.00	16.76	12.60
University of Nairobi	200	1.00	40.00	14.78	5.92
Makerere University	200	1.00	76.00	7.61	7.76
A. A. U, Ethiopia	200	1.00	55.00	7.58	8.19
University of Zambia	200	1.00	33.00	4.50	4.60
University of BUEA	200	1.00	31.00	7.04	4.47
UAN Angola	200	1.00	38.00	4.32	5.49
University of Ibadan	200	6.00	76.00	16.76	8.44
KNUST	200	3.00	47.00	9.35	5.67
UNIPORT	200	1.00	38.00	8.71	8.03

Table 2 presents the mean and standard deviation of the faculty's h-index in each of the 15 African universities. The University of Cape Town has 32.80 and 15.66, respectively, as the mean and standard deviation. University of Pretoria has 23.96 and 12.20 respectively as mean and standard deviation. The University of Zimbabwe has 4.28 and 6.21 as mean and standard deviation, and Cairo University has 21.16 and 11.83 as mean and standard deviation. The mean and standard deviation of Al Akhawayn University is 9.59 and 8.94; the mean and standard deviation of UTE, Tunisia is 16.76 and 12.60; the mean and standard deviation of University of Nairobi is 14.78 and 5.92; the mean and standard deviation of Makerere University is 7.61 and 7.76; while that of A. A. U, Ethiopia is 7.58 and 8.19. The mean and standard deviation of University of Zambia is 4.50 and 4.60; the mean and standard deviation of the University of Buea, Cameroon is 7.04 and 4.47, while the mean and standard deviation of UAN, Angola is 4.32 and 5.49. The University of Ibadan has 16.76 mean, and 8.44 standard deviation; KNUST has 9.35 mean, and 5.67 standard deviation;

and University of Port-Harcourt has a mean and standard deviation of 8.71 and 8.03, respectively. From the Table 2, it is clear that three of the universities, University of Cape Town, University of Pretoria, and Cairo University each has a mean of h-index that is far greater than the means of the remaining 12 universities.

Research Question Two

What is the difference in h-index of faculty among the regions in Africa?

Table 3: Mean and standard deviation of h-index of faculty among the regions in Africa

H-index of Regions in Africa	N	Minimum	Maximum	Mean	Std. Deviation
H-index of Southern Africa	600	1.00	126.00	20.26	16.90
H-index of North Africa	600	1.00	128.00	15.83	12.19
H-index of West Africa	600	1.00	76.00	11.60	8.32
H-index of East Africa	600	1.00	76.00	9.99	8.09
H-index of Central Africa	600	1.00	38.00	5.28	5.02

In Table 3, the mean and standard deviation of h-index of faculty in the five African regions is presented. The mean and standard deviation of h-index of Southern Africa is 20.26 and 16.90, the mean and standard deviation of h-index of North Africa is 15.83 and 12.19. The mean and standard deviation of h-index of West Africa is 11.60 and 8.32, the mean and standard deviation of h-index of East Africa is 9.99 and 8.09, while the mean and standard deviation of h-index of Central Africa is 5.28 and 5.02. Southern Africa, North Africa and West Africa are the regions with highest h-indexes, while Central Africa has the smallest mean.

Research Question Three

What is the difference in faculty's h-index in each African university and the average world h-index?

Table 4: Comparison of mean h-index of faculty in Africa Universities and world average h-index

Universities	N	Mean	World h-index	Std. Deviation
University of Cape Town	200	32.80	17.5	15.66
University of Pretoria	200	23.69	17.5	12.20
University of Zimbabwe	200	4.28	17.5	6.21
Cairo University	200	21.16	17.5	11.83
Al Akhawayn University	200	9.59	17.5	8.94
UTE,TUNISIA	200	16.76	17.5	12.60
University of Nairobi	200	14.78	17.5	5.92
Makerere University	200	7.61	17.5	7.76
A. A. U, Ethiopia	200	7.58	17.5	8.19
University of Zambia	200	4.50	17.5	4.60
University of BUEA	200	7.04	17.5	4.47
UAN Angola	200	4.32	17.5	5.49
University of Ibadan	200	16.76	17.5	8.44
KNUST	200	9.35	17.5	5.67
UNIPORT	200	8.71	17.5	8.03

It can be discerned clearly from Table 4 that University of Cape Town, University of Pretoria and Cairo University have mean h-index of 32.80, 23.69 and 21.16 that is each higher than the world average h-index of 17.5. All the other 12 universities have mean h-index that is smaller than the 17.5 world average h-index.

Research Question Four

What is the difference in h-index of the faculty in each African country and the average world h-index?

Table 5: Comparison of mean h-index of each African country and the average world h-index

Countries	N	Mean	World h-index	Std. Deviation
South Africa	400	28.25	17.5	14.74
Zimbabwe	200	4.28	17.5	6.21
Egypt	200	21.16	17.5	11.83
Morocco	200	9.59	17.5	8.94
Tunisia	200	16.76	17.5	12.60
Kenya	200	14.78	17.5	5.92
Uganda	200	7.61	17.5	7.76
Ethiopia	200	7.58	17.5	8.19
Zambia	200	4.50	17.5	?4.60
Cameroon	200	7.04	17.5	4.47
Angola	200	4.32	17.5	5.49
Nigeria	400	12.73	17.5	9.16
Ghana	200	9.35	17.5	5.67

The Table 5 compares the mean h-index of each African country and the average world h-index. South Africa and Egypt with h-index of 28.25 and 21.28, respectively, have h-index that are higher than the average world h-index of 17.5. The rest of the African countries – Zimbabwe 4.28, Morocco 9.59, Tunisia 16.76, Kenya14.78, Uganda 7.61 and Ethiopia 7.58 all have far less h-index in comparison with the world h-index of 17.5. Also, Zambia 4.50, Cameroon 7.04, Angola 4.32, Nigeria 12.73, and Ghana 9.35 are all much lower than the world average h-index of 17.5.

Research Question Five

What is the difference in citation index of the faculty among African universities?

Table 6: Mean and standard deviation of citation index of faculty among African universities

	N	Minimum	Maximum	Mean	Std. Deviation
University of Cape Town	200	105.00	67769.00	5749.83	7958.94
University of Pretoria	200	19.00	38257.00	3026.67	4639.94
University of Zimbabwe	200	1.00	24691.00	299.10	1823.05
Cairo University	200	834.00	91134.00	3047.37	8492.64
Al Akhawayn University	200	1.00	946.00	38.97	106.06
UTE,TUNISIA	200	421.00	90252.00	2017.67	7809.72
University of Nairobi	200	399.00	6298.00	1041.34	922.57
Makerere University	200	9.00	27902.00	477.49	2054.85
A. A. U, Ethiopia	200	7.00	18551.00	478.67	1559.21

University of Zambia	200	1.00	4073.00	156.87	382.67
University of BUEA	200	1.00	3519.00	91.77	357.03
UAN Angola	200	1.00	8566.00	210.06	752.40
University of Ibadan	200	12.00	4565.00	155.95	369.27
KNUST	200	11.00	2814.00	288.00	437.36
UNIPORT	200	3.00	3120.00	165.08	369.03

The mean and standard deviation of citation index of the faculty in African universities are presented in Table 6 that has revealed that University of Cape Town, Cairo University and University of Pretoria each has a much higher citation index mean than those of the other 12 African universities. Of the remaining 12 universities, UTE, Tunisia and University of Nairobi each has a mean citation index that supersedes the mean citation index of each of the remaining 10 universities in Africa.

Specifically, the mean and standard deviation of citation index of the University of Cape Town is 5749.83 and 7958.94, the mean and standard deviation of citation index of University of Pretoria is 3026.67 and 4639.94, the mean and standard deviation of citation index of University of Zimbabwe is 299.10 and 1823.05. The mean and standard deviation of citation index of Cairo University is 3047.37 and 8492.64, the mean and standard deviation of citation index of Al Akhawayn University is 38.97 and 106.06, and the mean and standard deviation of citation index of UTE, Tunisia is 2017.67 and 7809.72. Also, the mean and standard deviation of citation index of the University of Nairobi is 1041.34 and 922.57, the mean and standard deviation of citation index of Makerere university is 477.49 and 2054.85; the mean and standard deviation of citation index of A. A. U, Ethiopia is 478.67 and 1559.21, the mean and standard deviation of citation index of University of Zambia is 156.87 and 382.67, and that of the University of Buea is 91.77 and 357.03. While the mean and standard deviation of UAN, Angola is 210.06 and 752.40, the mean and standard deviation of citation index of University of Ibadan is 155.95 and 369.27. The mean and standard deviation of the citation index of Kwame Nkurumah University of Science and Technology is 288.00 and 437.37, and the mean and standard deviation of citation index of University of Port-Harcourt is 165.08 and 369.03. The University of Cape Town, University of Pretoria, Cairo University, UTE, Tunisia, and the University of Nairobi are having mean citation index that is greater than 1000 each, while each of the other 10 universities has mean citation index that is less than 500.

Research Question Six
What is the difference in citation index of faculty among the regions in Africa?

Table 7: Mean and standard deviation of faculty's citation index among African regions

Region	N	Minimum	Maximum	Mean	Std. Deviation
Citation index for Southern Africa	600	1.00	67769.00	3025.20	5853.28
Citation index for North Africa	600	1.00	91134.00	1701.34	6766.74
Citation index for East Africa	600	7.00	27902.00	665.83	1601.20
Citation index for Central Africa	600	1.00	8566.00	152.90	530.49
Citation index for West Africa	600	3.00	4565.00	203.01	397.14

Table 7 presents the mean and standard deviation of the citation index of faculty in various regions of Africa. Southern Africa respectively has a mean citation index and standard deviation of 3025.20 and 5853.28, and North Africa has mean citation index and standard deviation of 1701.34 and 6766.74. East Africa has a mean citation index and standard deviation as 665.83 and 1601.20; while the mean citation index and standard deviation of Central Africa are 152.90 and 530.49, respectively. The mean citation index and standard deviation of West Africa are 203.01 and 297.14. From Table 7, Southern Africa, North Africa and East Africa can vary rightly be rated first, second and third highest regions with citation index. Central Africa has the least citation index mean.

Research Question Seven
What is the difference in citation index of the faculty in each African university and the average world citation index?
Table 8: Comparison of mean citation index of faculty among African universities and the average world citation index

Universities	N	Mean	World citation index	Std. Deviation
University of Cape Town	200	5749.83	971	7958.94
University of Pretoria	200	3026.67	971	4639.94
University of Zimbabwe	200	299.10	971	1823.05
Cairo University	200	3047.37	971	8492.64
Al Akhawayn University	200	38.97	971	106.06
UTE,TUNISIA	200	2017.67	971	7809.72
University of Nairobi	200	1041.34	971	922.57
Makerere University	200	477.49	971	2054.85
A. A. U, Ethiopia	200	478.67	971	1559.21
University of Zambia	200	156.87	971	382.67
University of BUEA	200	91.77	971	357.03
UAN Angola	200	210.06	971	752.40
University of Ibadan	200	155.95	971	369.27
KNUST	200	288.00	971	437.36
UNIPORT	200	165.08	971	369.03

It can be seen from Table 8, which compares the mean citation index of each African university with the world's average citation index (971). Cape Town University (5749.83), University of Pretoria (3026.67), Cairo University (3047.37), UTE, Tunisia (2017.67), and University of Nairobi (1041.134) has a mean citation index that is higher than the world average citation index. Whether each of the difference is statistically significant shall soon be determined with the hypotheses testing. The other 10 African universities each has a mean citation index that is smaller than the world's average citation index. The University of Zimbabwe (299.10), Al Akhawayn University (38.97), Makerere University (477.49), A. A. U., Ethiopia (478.67), University of Zambia (156.87), University of Buea (91.77), UAN, Angola (210.06), University of Ibadan (155.95), Kwame Nkurumah University of Science and

Technology (288.00), and University of Port Harcourt (165.05) each has a citation mean that is apparently smaller than the world parameter citation index (971).

Research Question Eight

What is the difference in citation index of each African country and with the average world citation index?

Table 9: Comparison of citation index of each African country with the average world citation index

Countries	N	Mean	World citation index	Std. Deviation
South Africa	400	4388.25	971	6647.49
Zimbabwe	200	299.10	971	1823.05
Egypt	200	3047.37	971	8492.64
Morocco	200	38.97	971	106.06
Tunisia	200	2017.67	971	7809.72
Kenya	200	1041.34	971	922.57
Uganda	200	477.49	971	2054.85
Ethiopia	200	478.67	971	1559.21
Zambia	200	156.87	971	382.67
Cameroon	200	91.77	971	357.03
Angola	200	210.06	971	752.40
Nigeria	200	155.95	971	369.27
Ghana	400	226.54	971	408.79

The Table 9 presents the comparison of citation index of each African country in comparison with the average world citation index. Only South Africa, Egypt, Tunisia and Kenya have mean citation index that is each greater than the parameter (971). The rest of African countries have citation index that is each lower than the world average citation index.

Hypothesis One

The h-index of faculties in African universities do not significantly differ from one another.

Table 10: One Way ANOVA of h-index of faculties in African universities

VAR00001

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	192594.208	14	13756.729	170.131	.000
Within Groups	241365.845	2985	80.860		
Total	433960.053	2999			

Table 10 presents the one-way ANOVA for h-index of faculties in African universities. The between groups has sum of squares of 192594.208, degrees of freedom of 14 and mean square of 13756.729. The within groups sum of square is 241365.845, with 2985 degrees of freedom, and 80.860 mean square. The total sum of square and degrees of freedom are 433960.053 and 2999, respectively. The F-value of the ANOVA is 170.131 with Sig. (p) of .000. Since P (.000) is less

than the chosen .05 alpha, the first null hypothesis is rejected. That is, the h-index of faculties in African universities is significantly different from one another. The relative significant difference as confirmed with Post hoc multiple comparisons is graphically illustrated in Figure 1.
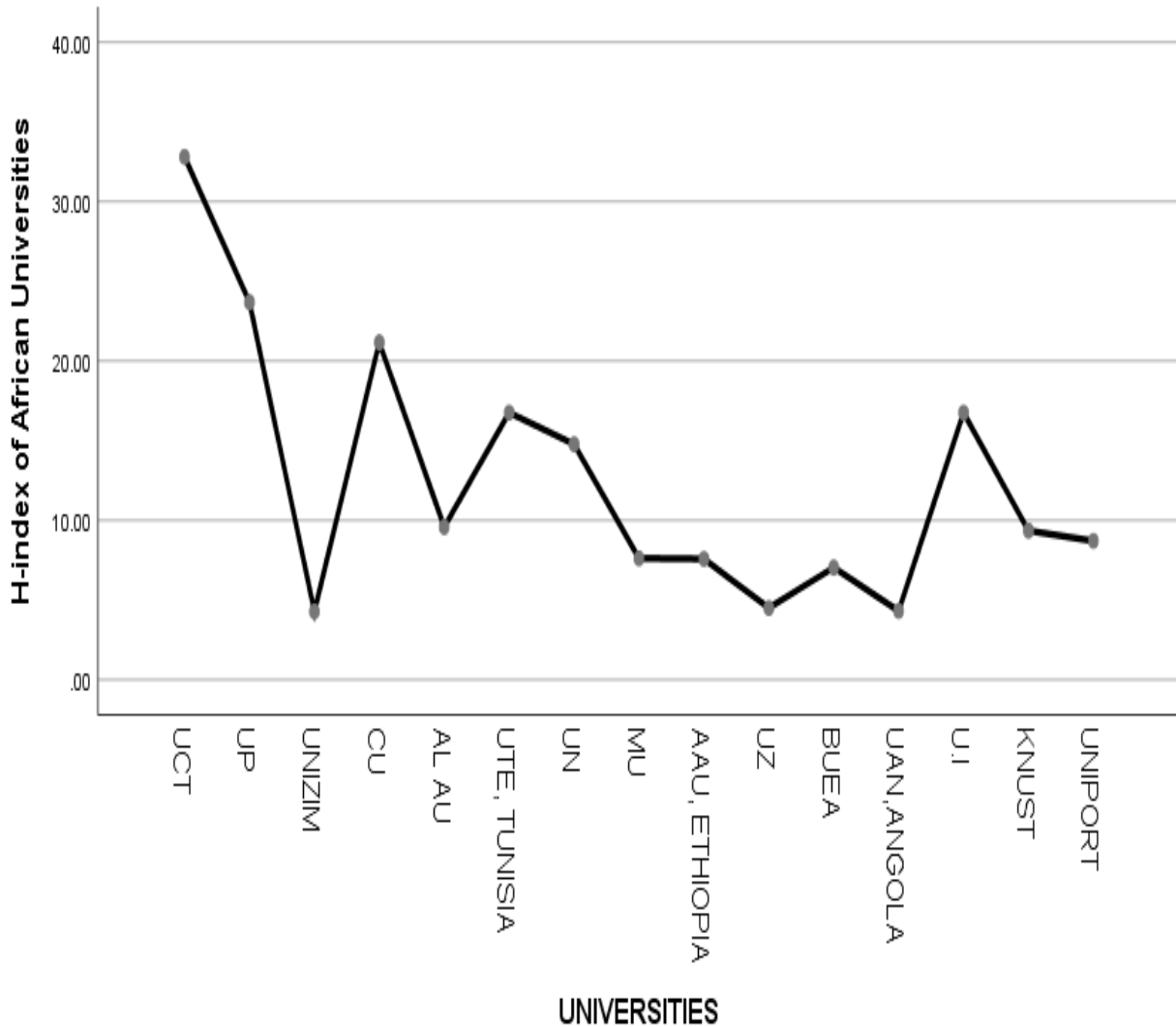

Figure 1: Means Plots of h-index of African Universities

The Mean Plots in Figure 1 shows that the mean h-index of faculty in African universities sharply varies. Figure 1 further confirms the significant difference established in the ANOVA and the Post Hoc tests of the h-indexes of the faculty in African universities. The h-index of University of Cape Town (UCT) is significantly greater than those of all the other African universities. University of Pretoria (UP) has h-index that is significantly greater than the h-index of each of the other African universities with the exception of UCT. UNIZIM, UZ, and UAN, Angola have h-index each that is significantly smaller than those of each of the other universities in Africa. With the exception of the University of Cape Town and the University of Pretoria, Cairo

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University (CU) has h-index that is significantly greater than the h-index of each of the other African universities. UTE, Tunisia and UI have h-index each that apart from UCT, UP and CU, is statistically higher than the h-index of each of the rest African universities. KNUST and UNIPORT have h-index that is each significantly more than those of UNIZIM, UZ and UAN, Angola.

Hypothesis Two
The h-index of faculties in the five regions of Africa do not significantly differ.

Table 11: One Way ANOVA of h-index of faculties in each region of Africa

Region	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	78238.598	4	19559.650	164.683	.000
Within Groups	355721.455	2995	118.772		
Total	433960.053	2999			

Table 11 presents the one-way ANOVA for h-index of faculties in each African region. The between groups sum of squares is 78238.598, with 4 degrees of freedom and a mean square of 19559.650. The within groups sum of square is 355721.455 with 2995 degrees of freedom and a mean sum of square of 118.772. Total sum of squares and degrees of freedom are 433960.053 and 2999, respectively. The computed F is 164.683 with Sig. (*p*) of .000 that is read as less than .0005. Since p (.000) is smaller than the chosen alpha of .05, the second null hypothesis is rejected [$F(4, 2995) = 164.683, p < .05$]. That is, the h-index of the faculty in each region of Africa is significantly different from those of the other African regions. Post hoc multiple comparisons were performed to determine the pairwise regions that differ significantly as presented in Table 12.

Table 12: Multiple Comparisons of h-index of faculties of each African region

Dependent Variable: Region
Scheffe

(I) VAR00002	(J) VAR00002	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Southern Africa	North Africa	4.42167*	.62921	.000	2.4824	6.3610
	East Africa	10.26667*	.62921	.000	8.3274	12.2060
	Central Africa	14.97167*	.62921	.000	13.0324	16.9110
	West Africa	8.65000*	.62921	.000	6.7107	10.5893
North Africa	Southern Africa	-4.42167*	.62921	.000	-6.3610	-2.4824
	East Africa	5.84500*	.62921	.000	3.9057	7.7843
	Central Africa	10.55000*	.62921	.000	8.6107	12.4893
	West Africa	4.22833*	.62921	.000	2.2890	6.1676
East Africa	Southern Africa	-10.26667*	.62921	.000	-12.2060	-8.3274
	North Africa	-5.84500*	.62921	.000	-7.7843	-3.9057
	Central Africa	4.70500*	.62921	.000	2.7657	6.6443
	West Africa	-1.61667	.62921	.159	-3.5560	.3226
Central Africa	Southern Africa	-14.97167*	.62921	.000	-16.9110	-13.0324
	North Africa	-10.55000*	.62921	.000	-12.4893	-8.6107
	East Africa	-4.70500*	.62921	.000	-6.6443	-2.7657
	West Africa	-6.32167*	.62921	.000	-8.2610	-4.3824
West Africa	Southern Africa	-8.65000*	.62921	.000	-10.5893	-6.7107
	North Africa	-4.22833*	.62921	.000	-6.1676	-2.2890
	East Africa	1.61667	.62921	.159	-.3226	3.5560
	Central Africa	6.32167*	.62921	.000	4.3824	8.2610

*. The mean difference is significant at the 0.05 level.

Table 12 presents the multiple comparisons of the h-index of faculty in the five African regions. The Table shows significant difference between the regions at .000 Sig. (read as less than .0005 alpha) for each of the pairs, except for East Africa and West Africa that is insignificant statistically as the Sig. (0.159) is greater than .05 chosen alpha. For each of the pairs, the asterisk depicts that the difference is statistically significant in favour of the region with a higher mean. The Sig. of .000 indicates that the significant difference is indeed overwhelmingly so even at less than .0005 alpha. Specifically, h-index of the scholars in Southern Africa is significantly greater than the h-index of the faculty in North Africa, East Africa, West Africa, and Central Africa. The h-index in North Africa is significantly higher than that of East Africa, West Africa, and Central Africa. The h-index for East Africa is significantly greater than that of Central Africa, but there is no significant difference between that of East Africa and West Africa. West Africa has h-index that is significantly higher than that of Central Africa. The differences are pictorially exhibited in Figure 2.
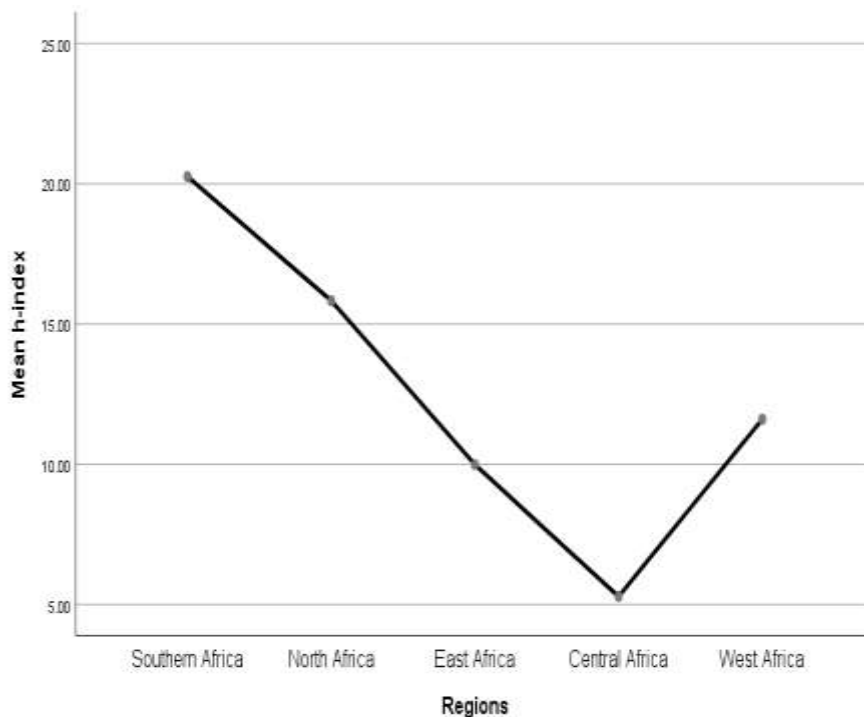
Figure 2: Means Plots of h-index of the regions in Africa

Figure 2 is the means plots of h-index of faculty in each of the African regions. The graph substantially slopes downwards from Southern Africa through North Africa and East Africa to Central, after which it accelerates upwards to finally terminate in West Africa. The means plots also accurately corroborates the significant ANOVA *F* and the significant Post hoc multiple comparisons.

Hypothesis three
There is no significant difference in faculty's h-index between each African university and the average world h-index.

Table 13: One-Sample t-test of h-index of faculties in each African university and the average world h-index

					95% Confidence Interval of the Difference	
Universities	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
UC T	22.343	199	.000	15.30000	5.3376	7.4764
U. P	7.175	199	.000	6.19000	4.4888	7.8912
UNIZIM	-30.110	199	.000	-13.22500	-14.0911	-12.3589
C U	4.374	199	.000	3.66000	2.0101	5.3099
Al A U	-12.523	199	.000	-7.91000	-9.1613	-6.6687
U T E , Tunisia	-.836	199	.404	-.74500	-2.5015	1.0115
U. N	-6.515	199	.000	-2.72500	-3.5498	-1.9002
MU	-18.016	199	.000	-9.89000	-10.9725	-8.8075
A. A. U, E	-17.132	199	.000	-9.92000	-11.0619	-8.7781
U.Z	-39.999	199	.000	-13.00000	-13.6409	-12.3591
Buea	-33.098	199	.000	-10.46500	-11.0885	-9.8415
UAN, Angola	-33.978	199	.000	-13.18500	-13.9502	-12.4198
U. I.	-1.248	199	.214	-.74500	-1.9224	.4324
KNUST	-20.325	199	.000	-8.15000	-8.9407	-7.3593
UNIPORT	-15.472	199	.000	-8.79000	-9.9103	-7.6697

The Table 13 presents One-sample t test of faculty in each African university and the average world h-index of 17.5. For the University of Cape Town, the computed t is 22.343 with 199 degrees of freedom and a p (Sig.) of .000 that is less than the chosen .05 alpha. The difference as reflected by the t value is statistically significant in favour of the University of Cape Town (UCT). Even when one-fifteenth of the chosen .05 alpha for the 15 comparisons, which is equal to .003 is used instead as the alpha to overcome the likely issues associated with multiple t tests, the difference remains significant. For the University of Pretoria, there is a significant difference in favour of University of Pretoria h-index [$t(199) = 7.175$, p < .05]. For the University of Zimbabwe, there is a statistically significant difference in favour of the average world h-index [$t(199) = -30.110$, p < .05]. For Cairo University, a significant difference exists in favour of Cairo University [$t(199) = 4.374$, p < .05]. For Al Akhawayn University, there is a significant difference in favour of the world average h-index [$t(199) = -12.523$, p < .05]. The h-index of faculty in UTE, Tunisia does not differ significantly from the world average h-index [$t(199) = -.836$, p > .05]. The University of Nairobi has h-index that is significantly smaller than that of the world average [$t(199) =-6.515$, p < .05]. The h-index of Makerere University is significantly lower than the world parameter [$t(199) = -18.016$, p < .05]. Addis Ababa University, Ethiopia has significantly lower h-index than the world parameter h-index [$t(199) = -17.132$, p < .05]. The University of Zambia has significantly small h-index that is overwhelmingly lower than the world parameter h-index [$t(199) = -39.999$, p < .05]. There is a significant difference between the h-index of the University of Buea, Cameroon and the average world h-index in favour of the world parameter [$t(199) = -33.098$, p < .05]. Universidade Agostinho Neto, Angola has h-index that is significantly

lower than the world average h-index [t(199) = -33.978, p < .05]. The h-index of University of Ibadan does not significantly differ from the world parameter [t(199) = -1.248, p > .05]. The h-index of Kwame Nkurumah University of Science and Technology is significantly lower than that of the world average [t(199) = -20.325, p < .05]. The University of Port-Harcourt has h-index that is statistically smaller than that of the world parameter [t(199) =-15.472, p < .05]. In all, only University of Cate Town, University of Pretoria and Cairo University that each has h-index which significantly exceeds 17.5 – the world average; only UTE, Tunisia and University of Ibadan have h-index each that does not vary significantly from the world parameter. The rest of the universities in Africa each has h-index that is significantly smaller than the average world h-index. In each of the cases with a significant difference, use of .003 (one-fifteenth of .05) does not alter the significance.

Hypothesis Four
There is no significant difference in h-index of faculty in each African country and the average world h-index.
Table 14: One-Sample t-test for h-index of faculties in each African country and the average world h-index

	Test Value = 17.5					
					95% Confidence Interval of the Difference	
	t	**Df**	**Sig. (2-tailed)**	**Mean Difference**	**Lower**	**Upper**
South Africa	14.575	399	.000	10.74500	9.2957	12.1943
Zimbabwe	-30.110	199	.000	-13.22500	-14.0911	-12.3589
Egypt	4.374	199	.000	3.66000	2.0101	5.3099
Morocco	-12.523	199	.000	-7.91500	-9.1613	-6.6687
Tunisia	-.836	199	.404	-.74500	-2.5015	1.0115
Kenya	-6.515	199	.000	-2.72500	-3.5498	-1.9002
Uganda	-18.016	199	.000	-9.89000	-10.9725	-8.8075
Ethiopia	-17.132	199	.000	-9.92000	-11.0619	-8.7781
Zambia	-39.999	199	.000	-13.00000	-13.6409	-12.3591
Cameroon	-35.514	198	.000	-10.57538	-11.1626	-9.9882
Angola	-33.978	199	.000	-13.18500	-13.9502	-12.4198
Nigeria	-10.405	399	.000	-4.76750	-5.6683	-3.8667
Ghana	-20.325	199	.000	-8.15000	-8.9407	-7.3593

It can most crystally be discerned from Table 14 that only two of African countries, South Africa [t(399) = 14.575, p < .05] and Egypt [t(199) = 4.374, p < .05] that each has significantly greater h-index than the world average h-index. With the exception of Tunisia that does not significantly differ from the world parameter h-index [t(199) = -.836, p > .05], each of the other African countries has h-index that is smaller significantly from the world average h-index (17.5). Precisely, faculty in Zimbabwe have h-index that is significantly lower than the world parameter [t(199 = -30.110, p < .05]. Faculty in Morocco have significantly lower h-index than that of the world average [t(199) = -12.523, p < .05]. The h-index of Kenya is smaller significantly than the

world average [t(199) = -6.515, p < .05]. Uganda has significantly lower h-index than the world parameter [t(199) = -18.016, p < .05]. Ethiopia's h-index is lower significantly than the world average [t(199) = -17.132, p < .05]. The h-index in Zambia is significantly smaller than that of the world average [t(199) = -39.999, p < .05]. The h-index of Cameroon is significantly smaller than the world parameter h-index [t(199) = -35.514, p < .05]. Angola has statistically lower h-index than that of the world parameter [t(199) = -33.978, p < .05]. Similarly, the h-index in Nigeria is lower significantly than the world average [t(399) = -10.405, p < .05]. Lastly, Ghana has h-index that is statistically smaller than the world parameter h-index [t(199) -20.325, p < .05].

Hypothesis Five
There is no significant difference in citation index of faculty among African universities.
Table 15: ANOVA **of** citation index among faculties of each African university

Universities	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	7519460574.367	14	537104326.740	35.008	.000
Within Groups	45796598751.100	2985	15342244.138		
Total	53316059325.467	2999			

The Table 15 presents the one-way ANOVA for citation index of faculty in African universities. The between groups sum of squares is 7519460574.367 with 14 degrees of freedom and 537104326.740 mean square. The within groups has 45796598751.100 sum of squares, 2985 degrees of freedom, and 15342244.138 mean square. The total sum of squares and degrees of freedom are 53316059325.467 and 2999, respectively. The computed *F* is 35.008 that is statistically significant at P (Sig.) of .000, read as less than ,0005. Since the P (.000) is smaller than the chosen alpha of .05, the null hypothesis of 'no significant difference in citation index of faculty among African universities' is rejected. That is, there is indeed, a statistically significant difference in the citation index of faculty among the universities in Africa as graphically portrayed in Figure 3.
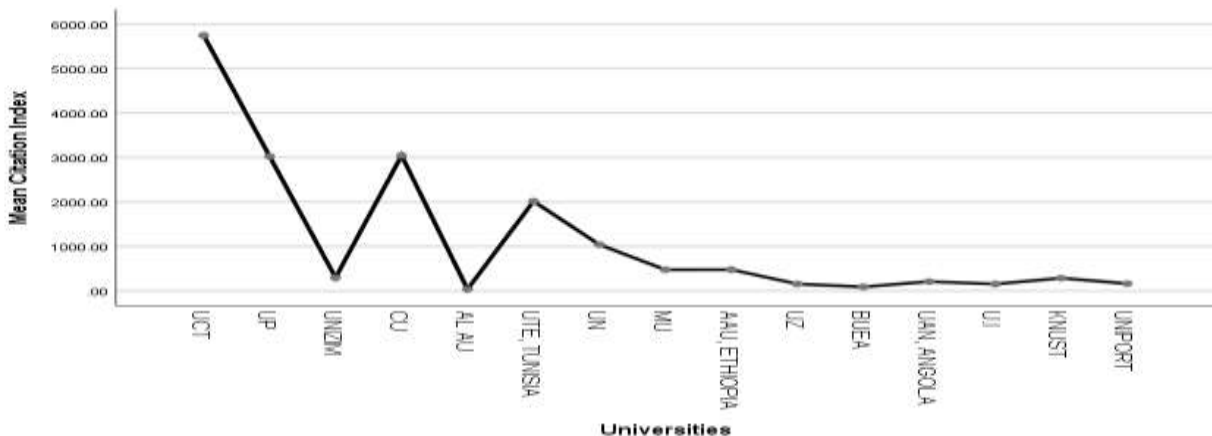

Figure 3: Means Plots of citation index of African universities

Figure 3 shows that the mean citation index of faculty from the various African universities statistically differ sharply to precisely reflect the significant difference established in the omnibus ANOVA (*F*) and the Post hoc multiple comparisons. The Post hoc multiple comparisons reveals that the citation index in the University of Cape Town is significantly greater than the citation index of each of the rest universities in Africa. Except for the University of Cape Town; the University of Pretoria and Cairo University each has a citation index that is significantly greater than the citation index of every one of the other universities in Africa. Furthermore, UTE Tunisia has citation index that is significantly higher than that of University of Nairobi, University of Zimbabwe, Makerere University, AAU Ethiopia, University of Zambia, University of Buea, UAN Angola, University of Ibadan, Kwame Nkrumah University of Science and Technology, and University of Port Harcourt. Also, the citation index of the University of Nairobi is significantly higher than that of each of UNIZIM, AL AU, MU, AAU Ethiopia, UZ, BUEA, UAN Angola, UI, KNUST, and UNIPORT. Of these other African universities (those that the University of Nairobi exceeds) with exception of the Makerere University and AAU Ethiopia that are each having significantly higher citation index than the University of Buea and AL AU, there is no statistically significant difference in their citation index. That is, the citation indexes of UNIZIM, AL AU, UZ, BUEA, UAN Angola, UI, KNUST, and UNIPORT do not differ significantly.

Hypothesis Six
There is no significant difference in citation index of faculties in the five regions of Africa.
Table 16: ANOVA of citation index of faculties among each region of Africa

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3567463320.047	4	891865830.012	53.693	.000
Within Groups	49748596005.420	2995	16610549.584		
Total	53316059325.467	2999			

It can be seen from Table 16 that the between groups sum of squares is 3567463320.047 with 4 degrees of freedom and 891865830.012 mean square. The within groups sum of square is 49748596005.420 with 2995 degrees of freedom, and 16610549.584 mean square. Total sum of squares and degrees of freedom are respectively 53316059325.467 and 2999. The F computed is 53.693 with a P value (Sig.) of .000. Since P (.000) is smaller than the chosen alpha of.05, we the null hypothesis of 'no significant difference in citation index of faculties in the five regions of Africa' is reject. That is, there is a statistically significant difference in the faculty's citation index with regards to African regions. Specification of the pairs of regions that vary significantly is provided in the Post hoc multiple comparisons in Table 17.

Table 17: Multiple Comparisons of citation index of faculty among African regions

Dependent Variable: VAR00001

Scheffe

(I) VAR00002	(J) VAR00002	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Southern Africa	North Africa	1323.86333*	235.30512	.000	598.6196	2049.1070
	East Africa	2359.36667*	235.30512	.000	1634.1230	3084.6104
	Central Africa	2872.30333*	235.30512	.000	2147.0596	3597.5470
	West Africa	2822.19167*	235.30512	.000	2096.9480	3547.4354
North Africa	Southern Africa	-1323.86333*	235.30512	.000	-2049.1070	-598.6196
	East Africa	1035.50333*	235.30512	.001	310.2596	1760.7470
	Central Africa	1548.44000*	235.30512	.000	823.1963	2273.6837
	West Africa	1498.32833*	235.30512	.000	773.0846	2223.5720
East Africa	Southern Africa	-2359.36667*	235.30512	.000	-3084.6104	-1634.1230
	North Africa	-1035.50333*	235.30512	.001	-1760.7470	-310.2596
	Central Africa	512.93667	235.30512	.314	-212.3070	1238.1804
	West Africa	462.82500	235.30512	.424	-262.4187	1188.0687
Central Africa	Southern Africa	-2872.30333*	235.30512	.000	-3597.5470	-2147.0596
	North Africa	-1548.44000*	235.30512	.000	-2273.6837	-823.1963
	East Africa	-512.93667	235.30512	.314	-1238.1804	212.3070
	West Africa	-50.11167	235.30512	1.000	-775.3554	675.1320
West Africa	Southern Africa	-2822.19167*	235.30512	.000	-3547.4354	-2096.9480
	North Africa	-1498.32833*	235.30512	.000	-2223.5720	-773.0846
	East Africa	-462.82500	235.30512	.424	-1188.0687	262.4187
	Central Africa	50.11167	235.30512	1.000	-675.1320	775.3554

*. The mean difference is significant at the 0.05 level.

For each pair of regions that is statistically different in their citation index, an asterisk is assigned, the Sig. is smaller than .05, and the 95% Confidence Interval Lower bound and Upper Bound are both either above zero of below zero. The region that a significant difference favours has a higher greater mean than the other. The citation index of South Africa is significantly greater than that of each of the other African regions at less than .0005 alpha. Apart from South Africa, North Africa has citation index that is significantly higher than that of each of the remaining regions in Africa at least at .001 alpha. East Africa, Central Africa and West Africa do not significantly vary in their citation index [p > .05]. Graphic illustration of the multiple comparisons is shown in Figure 4.
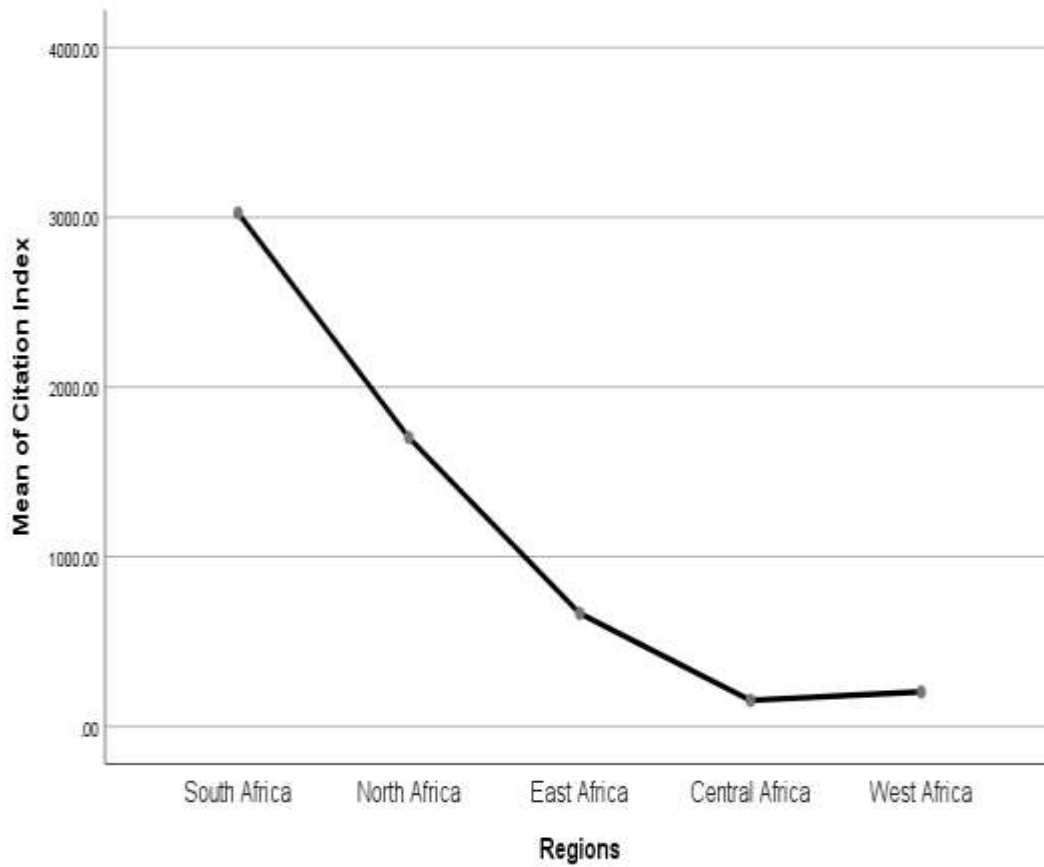
Figure 4: Means Plots of African regional citation index

The nature of the slope of the means plot in exactly confirms the ANOVA output in Table 16 and the Multiple comparisons in Table 17. It depicts that the citation index of scholars in South Africa is significantly higher than that of North Africa, which is in turn greater significantly than that of East Africa, that does not differ significantly from the citation index of Central Africa and West Africa.

Hypothesis Seven

There is no significant difference between the citation index of faculty in each African university and the average world citation index.

Table 18: One-Sample t-test of citation index of faculties in each African university and the average world citation index

	Test Value = 971						
Universities	**t**	**df**	**Sig. (2-tailed)**	**(2-Mean Difference**	**95% Interval Difference Lower**	**Confidence of the Upper**
UCT	8.491	199	.000	4778.83000	3669.0485	5888.6115
U P	6.265	199	.000	2055.66500	1408.6788	2702.6512
UNIZIM	-5.212	199	.000	-671.90000	-926.1032	-417.6968
C U	3.458	199	.001	2076.37000	892.1700	3260.5700
Al A U	-124.276	199	.000	-932.03500	-946.8241	-917.2459
UTE Tunisia	1.895	199	.059	1046.67000	-42.3042	2135.6442
U N	1.078	199	.282	70.33500	-58.3069	198.9769
MU	-3.396	199	.001	-493.51000	-780.0350	-206.9850
AAU Ethiopia	-4.465	199	.000	-492.33000	-709.7443	-274.9157
U Z	-30.087	199	.000	-814.13500	-867.4944	-760.7756
Buea	-34.827	199	.000	-879.23500	-929.0184	-829.4516
UAN Angola	-14.303	199	.000	-760.94500	-865.8587	-656.0313
U I	-31.215	199	.000	-815.05500	-866.5448	-763.5652
KNUST	-22.085	199	.000	-683.00000	-743.9842	-622.0158
UNIPORT	-30.885	199	.000	-805.92500	-857.3816	-754.4684

The results in Table 18 have revealed that of the universities in Africa, only three (University of Cape Town, University of Pretoria, and Cairo University) that each has citation index that is significantly greater than that of the world parameter (971). In addition, only two of the African universities (University of Tunis El Manar, and University of Nairobi) that do not differ significantly from the world average in their respective citation index. The rest of the universities in Africa (UNIZIM, Al AU, MU, AAU Ethiopia, UZ, Buea, UAN Angola, UI, KNUST, and UNIPORT) each has a citation index that is significantly lower than the world parameter.

Hypothesis Eight
There is no significant difference between faculty's citation index in each African country and the average world citation index.
Table 19: One-Sample t-test for citation index of faculties in each African country and the average world citation index.

Countries	t	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Test Value = 971	
					Lower	Upper
South Africa	10.281	399	.000	3417.24750	2763.8237	4070.6713
Zimbabwe	-5.212	199	.000	-671.90000	-926.1032	-417.6968
Egypt	3.458	199	.001	2076.37000	892.1700	3260.5700
Morocco	-124.276	199	.000	-932.03500	-946.8241	-917.2459
Tunisia	1.895	199	.059	1046.67000	-42.3042	2135.6442
Kenya	1.078	199	.282	70.33500	-58.3069	198.9769
Uganda	-3.396	199	.001	-493.51000	-780.0350	-206.9850
Ethiopia	-4.465	199	.000	-492.33000	-709.7443	-274.9157
Zambia	-53.606	199	.000	-843.96465	-875.0128	-812.9165
Cameroon	-34.827	199	.000	-879.23500	-929.0184	-829.4516
Angola	-14.303	199	.000	-760.94500	-865.8587	-656.0313
Ghana	-31.215	199	.000	-815.05500	-866.5448	-763.5652
Nigeria	-36.423	399	.000	-744.46250	-784.6449	-704.2801

It is crystally clear from Table 19 that while only two African countries (South Africa and Egypt) each has citation index that is greater significantly than that of the world average, two countries (Tunisia and Kenya) do not significantly differ from the world parameter. The rest of African countries (Zimbabwe, Morocco, Uganda, Ethiopia, Zambia, Cameroon, Angola, Ghana, and Nigeria) each has a citation index that is significantly smaller than the world average citation index.

CONCLUSIONS

This research comparatively investigated the research productivity of the faculty in African universities and used the world averages of the best indicators of research productivity (h-index and citation index) as the yardsticks. Research productivity was accurately measured with the h-index and citation index that were validly and reliably obtained from Google Scholar citation database, the world's largest and most authentic scholar's citation database. Data collected were subjected to rigorous statistical analyses with SPSS Statistics for ANOVA and Single-sample *t* test at .05 level of significance for the determination of the tenability of the null hypotheses, while the research questions were answered with descriptive statistics. In synopsis, the entire findings have shown the following among other very crucially essential results.

- University of Cape Town, University of Pretoria, and Cairo University each has overwhelmingly higher h-index than the rest of universities in Africa. University of Zimbabwe, University of Zambia, and Universidade Agostinho Neto, Angola have the least h-index of the sampled institutions in the continent.

- Southern Africa and North Africa each has awesomely greater h-index than any of the regions in Africa. Central Africa has the lowest h-index in Africa.

- Of the universities in Africa, only University of Cape Town (32.80), University of Pretoria (23.69), and Cairo University (21.16) that each has h-index mean that is substantially above the world parameter of 17.50. Apart from the University of Tunis El Manar and University of Ibadan, all the other African universities are each having h-index that is ridiculously smaller than the average world h-index.

- South Africa (28.25) and Egypt (21.28) are the only African countries that each has mean h-index, which extensively exceeds the average world h-index of 17.50. Countries like Zimbabwe, Angola and Zambia have h-index that is even lower than 5 each.

- University of Cape Town (5749.83), University of Pretoria (3026.67), Cairo University (3047.37) and UTE, Tunisia (2017.67) are the leading universities with the highest mean citation index in Africa. On the contrary, Al Akhawayn University (38.97) and the University of Buea (91.77) each has a mean citation index that is below 100.

- Southern Africa with a mean of 3025.20 and North Africa with a mean of 1701.34 are first and second, respectively, in terms of citation index in African regions. West Africa (mean of 203.01) and Central Africa (mean of 152.90) have average citation index each that is less than 210.

- The University of Cape Town with 5749.83 mean, the University of Pretoria with 3026.67 mean, and Cairo University with 3047.37 mean are the only universities in Africa that each has citation index that is substantially greater than the world average citation index.

- Only South Africa (4388.25 mean) and Egypt (3047.37 mean) that each has a considerably higher mean citation index than the world average of 971.

- The h-index of faculty in the different African universities significantly vary. The University of Cape Town has the highest h-index, followed respectively by University of Pretoria and Cairo University, each of which is significantly higher than that of every other university in the continent.

- There is a significant regional difference in the h-index of faculty in Africa. The h-index of scholars in Southern Africa is significantly higher than that of each of the other regions. Also, the h-index in North Africa is significantly higher than that of East Africa, West Africa and Central Africa.

- The h-index of universities in Africa differ significantly from that of the world average. While h-index of University of Cape Town, University of Pretoria, and Cairo University is each greater than the world average, h-index of University of Nairobi, University of Zimbabwe, Makerere University, AAU Ethiopia, University of Zambia, University of Buea, UAN Angola, KNUST, and UNIPORT each differs significantly from the world average h-index.

- The h-index of African countries are significantly different from that of the world average. While South Africa and Egypt each has h-index that is greater significantly than that of the world

average, Angola, Cameroon, Ethiopia, Ghana, Kenya, Morocco, Nigeria, Uganda, Zambia, and Zimbabwe each has h-index that is significantly lower than the world average.

- There is a statistically significant difference in the citation index of lecturers with regard to their university of affiliation in Africa. The faculty in University of Cape Town citation index is significantly greater than that of each of the other African universities, University of Pretoria and Cairo University citation index are each greater than that of UTE Tunisia, which is, in turn, higher significantly than those of the remaining African universities.

- A significant regional difference exists in citation index in Africa. South Africa has a citation index that is significantly greater than North Africa, which is in turn greater significantly than that of East Africa. East Africa, West Africa and Central Africa do not significantly vary in their citation index.

- Universities in Africa differ significantly from the world average citation index. While the citation index of University of Cape Town, University of Pretoria, and Cairo University are each higher significantly than that of the world average, the citation index of UNIZIM, MU, AAU Ethiopia, UZ, UB, UAN Angola, UI, KNUST and UNIPORT are each lower significantly than the world average.

- African countries differ significantly from the world average citation index. While South Africa and Egypt are significantly higher in citation index than the world average, Angola, Cameroon, Ethiopia, Ghana, Morocco, Nigeria, Uganda, Zambia, and Zimbabwe each has a significantly smaller citation index than the world average.

A comparative analysis of the research productivity of faculties based on institutions and regions in this study, also shows that the University of Cape Town and University of Pretoria are ranked top with average highest h-indexes, of 32.80 and 23.96, respectively; followed by the University of Cairo with 21.16 average h-index. The universities in South Africa dominated in area of impact of research than any other country in Africa. The dominance of South Africa in the area of research impact and productivity is corroborated by Lateef, Ogunkunle and Adigun, (2016). Lateef et al. posited that South Africa and Egypt ranked the first and second among the countries in terms of all indices considered. The indices they considered were total number of Google Scholar registered users, their h-index and i10-index. Among others, the highest h-index of South African faculty was 92, followed by Egypt's highest h-index of 75 at second position, and Nigeria with the highest h-index of 23 placed distant third (Lateef et al., 2016). There is no doubt that the analysis of variance proved to be significantly different in the mean h-indexes of the faculty in African universities. The dominance of South Africa in research impact among faculties in Africa may not be unconnected with the fact that more journals in South Africa are indexed in world citation impact indicators such as the Google Scholar, Institute of Science Information (ISI), Web of Science (WoS) that is currently referred to as Publons, and Scopus.

Pouris and Pouris (2009) gave an analysis of the state of science and technology in Africa between 2000 and 2004. They reported that Africa produced 68,945 publications within that time frame, representing 1.8% of the World's publications. They further stated that 23,335 of these 68,945 publications were from the North African countries (Egypt, Morocco and Tunisia), 20,762 were from South Africa, and the rest (24,848) were from all the other African countries. The analysis

showed that Sub-Saharan countries are not contributing meaningfully to the world's publications, with the exception of South Africa. It noted that 40 South African journals are indexed in Thomson Scientific's Citation indexes (Mouton & Gevers, 2009). "It is worrisome to note that 47 countries in the Sub-Saharan African region are only contributing 1.8% to global science". This speaks volumes of the quality of journals (including research) of this region. Africans need to have more journals indexed by ISI as this will ensure an international presence. Moreover, African researchers should be publishing in international high impact journals Pouris and Pouris (2009). The findings of Pouris and Pouris (2009) were corroborated by the results of the current study. Findings of the current investigation show that African countries are not contributing significantly to the world's research productivity as measured with h-index and citation index. The finding is also in line with what Kpolovie and Awusaku (2016) observed that ICT adoption attitude for research and teaching in South Africa in the best in Africa.

Research question two and hypothesis two from the analysis show that the h-index of faculty in the five regions of Africa are significantly different. The multiple comparisons between the regions also shows significant difference between the regions. It is only between East Africa and West Africa that the difference is insignificant. The means of Southern Africa and North Africa in particular, are high and quite different from the rest. Other findings showed that South Africa is more advantaged in terms of citation index and h-index probably because most of the South African journals are index in popular world citation databases. Africa's output of publications indexed in Thomson Reuters Web of Science databases between 1999 and 2008 showed the research output of South Africa to be 47,000 papers, Egypt to be 30,000 papers and Nigeria output during the period was only 10,000 papers. According to Gondwe (2010), the Global Research Report on Africa also categorized research output in Africa into 21 disciplines and Nigeria was ranked first only in one discipline (Agricultural Sciences) out of 21 disciplines and second in three out of the remaining 20 disciplines (Biology & Biochemistry, Pharmacology & Toxicology, and Psychiatry & Psychology) 4th in 4 disciplines (Clinical Medicine, Economics & Business, Environment/Ecology, and Plant & Animal Science) and fifth in one discipline (Neuroscience & Behaviour). Nigeria did not occupy the top five positions in the remaining 12 disciplines. On the other hand, South Africa was ranked 1st in 15 disciplines, 2nd in five disciplines and 4th in one discipline. South Africa did not appear below fourth position in any of the 21 disciplines. So, it is obvious south Africa dominates the ranking of Africa in research productivity, having shown more appearance in the world stage of research productivity measurement indicators. The report further revealed that "Malawi, with one-tenth the annual research output of Nigeria, produces research of a quality that exceeds the world average benchmark while Nigeria hovers around half that impact level."

According to Onyancha (2007), South African universities published 52,000 articles from 1995 to 2008 three times more than other African countries. South African universities also have more international collaboration in terms of research than other African countries. This no doubt has increased the h-index of University of Cape Town and of the University of Pretoria to be among the leading universities in Africa in the ranking by Times Higher Education (THE). This finding corroborated that by Lateef et al. (2016) who showed in their study that South Africa and Egypt ranked the first and second among the African countries in terms of all indices considered. The

top-rated researchers who had h-index of 92, 75 and 65 were found to be affiliated to South Africa, Egypt and Tunisia, respectively.

The University of Cape Town, University of Pretoria, Cairo University and UTE, Tunisia are the leading universities with the highest citation index. The test revealed that there is a significant difference in citation index among faculties of each African university. Lateef et al. (2016) in their study rated the university of Cape Town as the first in South Africa, Cairo university as first in Egypt and University of Ibadan as the leading university in Nigeria in terms of citation count ex-rayed from Google Scholar. Faculty from South Africa and Egypt have more Google Scholar Citation (GSC) counts compared with faculty from other countries in Africa. Ranking of several other public universities in the continent will have been better if their academic communities have impressive web presence by having GSC accounts. According to Lateef et al. (2016) "the low value of less than 100 registered users of first- and second-generation universities established in the range of 4-6 decades ago in Nigeria showed low-level of web presence of their scholars." This is also applicable to other regions, especially the Central and East African countries. There are some universities that do not even have a GSC profile, and none of the faculty has GSC account. No doubt that the statistical tests showed significant difference between universities in Africa.

Conspicuously, University of Cape Town, and University of Pretoria from South Africa together with Cairo University in Egypt, and UTE in Tunisia had their mean citation indexes to be significantly higher than the 971world average citation index. Almost all the other universities in Africa have citation index means, and h-index means that are significantly smaller than the world parameters. This explains why apart from one or two universities in South Africa and one university in Egypt, none of the African universities could make the first 500 universities in the ranking of world universities by Times Higher Education (2019). The Times Higher Education (THE) held her inaugural Africa summit in Johannesburg, South Africa and came up the ranking of first thirty universities in Africa. "South Africa dominated a snapshot of what a new ranking for African universities could look like, making up two-fifths of the institutions in the list. Egypt is the second most-represented country, with six universities in the top 30 table, which was drawn up by Times Higher Education that mainly measures research impact. Morocco and Tunisia both have three institutions making the running". Nigeria had only one university on the list of top 30 African universities (Times Higher Education, 2019).

South Africa, Zimbabwe, Egypt, Uganda, Ethiopia, Zambia, Cameroon, Angola, Nigeria and Ghana are significant different from the average world h-index. Tunisia and Kenya showed no significant variation from the world average h-index. Of the African countries that overwhelmingly differed from the world h-index parameter, only South Africa and Egypt that had their h-index mean greater than the test value (the world parameter of 17.50). The h-index of the rest countries were abysmally lower than the world average. South Africa and Egypt have dominated Africa in terms of research productivity probably because of their overwhelming presence in high profile bibliometric indexes like Google Scholar citation database, Scopus and Web of Science (Publons), etc. The negative outlook of Africa in terms of research productivity was earlier noted by Ajiferuke (2011) who used Web of Science database to analyze the contributions of researchers in Africa to the informetrics literature but with a broader coverage;

the time frame used was 1960 to September 2010, the period that data collected covered. Also, instead of looking at the contributions by year, he examined the contributions by each of the countries in Africa. The study used Scopus, the result showed that only 12 out of the 54 countries in Africa have contributed informetrics articles in journals indexed by either Web of Science or Scopus but alone South Africa and Nigeria seemed to have made significant contributions. Ajifureke (2011) also suggested that an African Citation Index should be developed and that African informetrics researchers should take advantage of freely available analytical tools.

Africa faculty, universities, and countries must do more to have their journals indexed internationally for the journals to contribute meaningfully to the indicators of research productivity. For instance, Bakuwa (2014) stated that the number of African journals indexed by ISI's Web of Science is low compared to the total number of journals published in Africa. According to him only about 40 out of 2503 accredited South African journals were indexed by Web of Science as of 2009. Mouton and Gevers (2009) analyzed South Africa's output in ISI journals and noted that most of the journals indexed in the ISI Web of Science are natural and health science journals. They observed that South Africa's output in ISI-journals has been dominated by the sciences (43-46%), followed by the health sciences (25-28%) and engineering (10%). Aina (2016) presented the number of journals published in Africa that are covered by Web of Science listing. It was discovered that only 5 out of the 217 (2.3%) journals published in Nigeria were covered by the Web of Science, South Africa had 55 out of the 94 journals (58.3%) covered by the Web of Science. The same trend was observed with Scopus, where 27 journals of the 217 journals published in Nigeria were covered by Scopus. Nigeria is ranked distant second and South Africa as the very first of the four Africa countries (South Africa, Nigeria, Ethiopia and Kenya) that have journals listed by the Web of Science and Scopus. However, when the proportion of journals covered by Web of Science and Scopus in relation to the number of journals listed in African Journal Online (AJOL) was examined, Nigeria was ranked last among the top four countries in Africa and South Africa was ranked first using both indicators.

The university authorities in Africa may need to retrace their administrative policies that tend to discourage the faculty from executing research frequently and getting them published in internationally indexed journals that are always accessible globally as university policies might be associated with the low h-index and citation index of the faculty. University management in Africa do too little or nothing to encouraging frequent quality research execution and international publications (Oloube, Agbor & Kpolovie, 2016; Kpolovie & Lale, 2017; Ololube, Egbezor, Kpolovie & Ekpeyong, 2019; Ololube & Kpolovie, 2012; Kpolovie & Iderima, 2016; Kpolovie & Akpelu, 2017). Promotion of faculty from one level to another in African universities dose not make any reference to the research productivity as measured with h-index and citation index. When promotion to even the peak rank does not specifically demand that the faculty's publications must have received a certain h-index and citation index, then it is right to say that the university policies do not recognize the relevance of research productivity. Ceaseless intensive research and publications of the findings are bound to improve with the right support and suitable administrative policies in African universities. There may not be a better time to formulate and implement policies that accord due attention to faculty's research productivity than now in African universities.

Finally, With the abysmal research productivity in African universities as epitomized by the findings, every university and each scholar in Africa is motivated absolutely to have a quality web presence to accurately reflect the institution's and faculty's research activities as measured with Google Scholar h-index and citation index. University authorities in Africa must reevaluate their web policy and substantially promote the quality and volume of their international publications that will automatically boost the institution's academic excellence, impact, openness and presence. The authorities of African universities must accord the required attention for the acceleration of research productivity by compelling every faculty to execute more and more research and publish the findings electronically in peer-refereed internationally indexed journals with uninterrupted accessibility.

In strict accordance with the findings, the following specific recommendations are made.

- Every faculty should, as a matter of urgent necessity, register in Google Scholar. Summary of research statistics as it regards total citation, h-index and i10 index of the faculty is automatically computed for each registered member by Google Scholar. Registration in Google Scholar citation database is free, no subscription for access, and it has extensive coverage.
- Each university or college should make it compulsory for her faculty to open google scholar citation account. The research productivity of an institution is to a considerable extent measured by the research impact of her faculty as provided by Google Scholar at zero cost to the institution and the faculty.
- African researchers should be publishing their works in internationally indexed journals that are globally accessible round-the-clock.
- African indigenous bibliometric indicators be created to measure and rank faculty's research productivity worldwide.
- Publications of African scholars that are in some non-visible media could be updated and republished in internationally accessible journals with the right indexing, highly impactful journals. This could boost the research productivity of academics and probably uplift the ranking of universities not only in Africa but globally.
- African faculty should collaborate with their counterparts in other regions, countries and continents as it could enhance the quality, coverage and knowledge sharing. Collaboration efforts will also broaden the horizon of African faculties.
- It is also of note that books published are most likely not captured in journals, but when published internationally online, the probability of the book reaching a wider audience and attracting greater citation is guaranteed. African authors should publish their quality books internationally.
- African faculty should be frequently engaging in executing high-quality research, novel works that will contribute immensely to the body of existing knowledge in the resolution of man's pressing problems.
- Staff annual appraisals in African universities should be based on h-index and citation index.
- The greatest of educational policies in this knowledge world can best be made based on research productivity indicators. Educational policymakers in Africa and the world must make use of research productivity indicators (h-index and citation index) as the basis of functional

policy formulation and implementation. Policies that are made can never be better than the evidence used to formulate them. Policies that are not data-based are bound to produce unwanted results.

- Universities in Africa must accord primary attention to improvement of faculty's research productivity as validly and reliably measured with Google Scholar h-index and citation index.

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