Quality: The Agenda

COMMISSION FOR UNIVERSITY EDUCATION

THE STATE OF UNIVERSITY EDUCATION IN KENYA: SELECTED PAPERS FROM THE 2ND BIENNIAL CONFERENCE, 2018

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2ND BIENNIAL CONFERENCE ON THE STATE OF HIGHER EDUCATION IN KENYA

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CONFERENCE PAPER REVIEWERS

Prof. Simon Onywere - Kenyatta University
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Prof. Jackson Too – Commission for University Education

FOREWORD

The Commission for University Education is established by the *Universities Act No. 42 of 2012, Revised 2018 {2016}* to regulate and assure quality in University Education in Kenya, by setting standards and guidelines on teaching, research and outreach; and monitoring compliance to achieve global competitiveness. The mandate of the Commission for University Education includes among others; promoting the objectives of university education in Kenya, promoting quality research and innovation, collecting, disseminating and maintaining data on university education as well as advising the Cabinet Secretary on Policy relating to university education. Research and innovation has been earmarked as one of the enablers of the Kenya Vision 2030. The Commission's role in the Second Medium Term Plan (2013-2017) is to develop quality and adequate human resource capacity through expanding access, relevance, equity and quality of university education as well as promotion of research, Science, Technology and Innovation.

The Commission with other stakeholders organized the 2nd Biennial Conference on the state of higher education in Kenya from 30th October to 2nd November 2018 to reflect on effective practices in the university sector, with a view of building a world class and globally competitive university education system. Key issues discussed included: the application of Science, Technology and Innovation for National Development; effective quality assurance mechanisms in Higher Education and Research; promoting technology transfer and Commercialization of University Research outputs; forging collaborations, partnerships and linkages in training and research and strengthening doctoral training and research.

This publication contains papers which have been subjected to a rigorous peer review process. We hope that it will be a key resource material for the academics, students and other stakeholders in the Higher Education Sub-Sector and lay a foundation for policy framework in the Ministry of Education.

PROF. CHACHA NYAIGOTTI-CHACHA
CHAIRMAN, COMMISSION FOR UNIVERSITY EDUCATION

ACKNOWLEDGEMENT

The 2nd Biennial Conference on State of University Education would not have been successful without the contribution of several people. We would like to express our appreciation to our sponsors; United Nations Scientific, Educational and Cultural Organization (UNESCO- Nairobi Regional Office), Kenya National Commission for UNESCO (KNATCOM), National Commission for Science, Technology and Innovation, National Research Fund, African Population and Health Research Center who gave generously towards the funding of the conference. We are greatly indebted to you.

We applaud the members of the Local Organizing Committee chaired by Prof. Jackson Too who worked tirelessly to organize the conference. We especially thank all the local, regional and international participants and the entire Commission for University Education fraternity who played various roles during the conference week and made it a great success.

Our gratitude also goes to Amb (Dr.) Amina Mohamed the former Cabinet Secretary, Ministry of Education and Prof. Collette A. Suda, former Principal Secretary, State Department of University Education - Ministry of Education; other Government officials and University representatives for their support during the planning, and for gracing the opening ceremony. In the same breadth, we acknowledge the immense contribution of all paper presenters, panellists and discussants, chair of sessions and rapporteurs without which this publication would not be realized.

I thank Prof. Simon Onywere of Kenyatta University and Dr. Jotham Wasike of Karatina University for spearheading review of the papers that were presented during the conference ensuring that the papers met the required threshold to be considered for publication. My appreciation also goes to the authors for working with us and submitting their final papers which are compiled in this publication.

I would like to express my deepest appreciation to the team in the Division of Planning, Research and Development for their commitment and resilience in ensuring successful compilation of the papers. These include: Prof. Jackson Too – Senior Assistant Commission Secretary, Research and Development, Ms. Hyrine Matheka – Senior Assistant Commission Secretary, Planning and

Resource Mobilization, Ms. Stella Kiptoo – Assistant Commission Secretary, Ms. Alice Kande – Senior Research Officer, Mr. Pius Walela - Senior Research Officer, Ms. Claris Adoyo - Research Officer, Mr. Reynold Nyaga – Planning Officer, Mr. Muriithi Njeru - Data Analyst, Ms. Lucia Muia- Secretary.

I recognize and appreciate all those who made some contribution but have not been mentioned by name, I sincerely thank you all.

PROF. MWENDA NTARANGWI
COMMISSION SECRETARY/CEO

ABBREVIATIONS AND ACRONYMS

AAU	Association of African Universities
AGT	Academy of Graphic Technologies
APHRC	African Population and Health Research Center
ATPS	African Technology Policy Studies
AWARD	African Women in Agricultural Research and Development
BOG	Board of Governors
CNHR	Consortium for National Health Research
CUCK	Cooperative University College of Kenya
CUE	Commission for University Education
EFA	Education for All
ESAMI	Eastern and Southern Africa Management Institute
GDP	Gross Domestic Product
GIS	Geographic Information System
HELB	Higher Education Loans Board
HSBS	Helping Students and Businesses Succeed
ICT	Information and Communication Technology
IDRC	International Development Research Centre
IITA	International Institute of Tropical Agriculture
ILO	International Labour Organization
IUCEA	Inter University Council of East Africa
JICA	Japan International Cooperation Agency
JKUAT	Jomo Kenyatta University of Science and Technology
JOOUST	Jaramogi Oginga Odinga University of Science and Technology
KAM	Kenya Association of Manufacturers
KEFRI	Kenya Forestry Research Institute
KENET	Kenya Education Network

KCSE	Kenya Certificate for Secondary Education
KTTC	Kenya Technical Training College
KU	Kenyatta University
KUCCPS	Kenya University Colleges Placement Service
MMUST	Masinde Muliro University of Science and Technology
MoE	Ministry of Education
NACOSTI	National Commission for Science, Technology and Innovation
NCPWD	National Council for Persons with Disabilities
NEMA	National Environment Management Authority
NRI	National Research Institute
PAUSTI	Pan African University Institute for Basic Sciences, Technology and Innovation
PGDE	Post Graduate Diploma in Education
PR	Public Relations
PTA	Parent-Teacher Association
PUEA	Presbyterian University of East Africa
SASA	Society for Advancement of Science
SDGs	Sustainable Development Goals
SEKU	South Eastern Kenya University
SSA	Sub Saharan Africa
ST&I	Science, Technology and Innovation
STISA	Science, Technology and. Innovation Strategy for Africa
TTUC	Taita Taveta University College
TUK	Technical University of Kenya
TVET	Technical and Vocational Education Training
UASU	University Academic Staff Union
UNEP	United Nations Environment Programme
UON	University of Nairobi
USIU-A	United States International University- Africa

TABLE OF CONTENTS

CONFERENCE SPONSORS

CONFERENCE THEME, SUBTHEMES & OBJECTIVES

Theme

Positioning Universities as the Nexus of Research, Innovation and Technology Transfer for Socio-Economic Transformation

Sub Themes

- Science, Technology and Innovation for National Development
- Quality Assurance in Higher Education and Research
- Technology Transfer/Commercialization of Research outputs
- Collaborations, Partnerships and Linkages
- Doctoral Training and Research

Conference Objectives

1. To generate ideas that will anchor policy frameworks which address pertinent and emerging issues in development of university education; and
2. To showcase research findings and innovations relevant to prioritized areas of national development.

OPENING SPEECH

Amb (Dr.) Amina Mohamed, former Cabinet Secretary, Ministry of Education, read by Prof. Collette Suda, former Principal Secretary in the State Department of University Education and Research Ministry of Education during the 2nd Biennial Conference on the State of University Education in Kenya

Ladies and Gentlemen:

It is my great pleasure to preside over this 2nd Biennial Conference on the State of University Education in Kenya especially because of its focus on *"***Positioning Universities as the Nexus of Research, Innovation and Technology Transfer for Socio-economic transformation.** Our country made the shift from a developing country to a middle-income country in 2014, signaling the positive socioeconomic changes we have made as a nation in the recent past. But we cannot settle for this current status because we are looking at advancing the livelihood of our citizens through industrialization and technological expansion. Universities are key in these advances because of their position as centers of research and innovation necessary to achieve our goals in Vision 2030 and the Big 4 Agenda.

Ladies and Gentlemen,

Research, innovation and technology drive development in the world today and that is why my Ministry has emphasized the role of STEM in the future of economic transformations of the country. Through research and innovation universities will provide the foundations and impetus necessary for such transformations. At the continental level the African Union's Science, Technology and Innovation Strategy for Africa framework for socio-economic transformation has laid the same emphasis on research and innovation. This country has been a leader in the region in terms of education, manufacturing, and investment. We cannot relent on this leadership nor on our work in shaping the future of our citizens. We have to continue providing technological and research leadership in the region and beyond but more specifically coming up with real solutions for challenges facing Kenyans daily.

The Government has invested a lot of resources in university education and expects that this investment will bear fruit that will change the lives of Kenyans. Universities, therefore, have to take their place as leaders in knowledge creation, research and innovation so as to find solutions

to the myriad of challenges facing our society. In the world we live in today we cannot help but ask ourselves what impact universities have made in the development of this country and beyond. Can our universities justify the investment and sacrifices made by the Government and Stakeholders to make them run? And with more than 70 universities currently operating in the country and a student population of close to 600,000 many would want to know what is their return on investment?

Ladies and Gentlemen,

I am pleased to see that a number of universities are showcasing some of the innovative projects they are engaged in through research geared towards solving real challenges facing our people and the nation. Some are looking at diversifying sources of essential nourishment through creatively raising food supplies from insects; others are looking at ways of reducing infant mortality in rural communities; and others are focusing on sustainable waste management systems. These and other projects being showcased at this conference are the kinds of research and innovations that will bring real solutions to many challenges facing our people. But we need more universities doing this kind of research.

We need more universities undertaking more Action Research and outreach so as to make an impact in society and remain relevant. We need to see more collaborations and partnerships between universities and communities. Let their researchers go out to the communities and listen to the challenges they face each day. Let them observe and go back to their institutions and design responses in the form of solutions. And then go back and work with the communities to test and apply their innovations to solve the identified problems. That way, communities can realize a return on the investment their government has put in the universities.

Similarly, let universities forge linkages with industry so that they can change the current scenario where universities and industries, while geared towards serving the same population, are often working in isolation or as silos. On the one hand, universities must take leadership in engaging with industry, involving them in their key activities such as curriculum development, teaching and internships. On the other, industries must see universities as invaluable resources to carry out much

needed research and deepen the utility of their products. It is through such collaborations that students will be better prepared for the world of work as expected by employers.

I am pleased to see that among participants at this conference are both university and industry representatives. Discussions and conversations between the two should lead to opportunities for future collaboration and consultation. You both need each other!

Ladies and Gentlemen,

As I noted earlier Science, Innovation and Technology Transfer is what will drive this country to the next frontier in development. And as I have just mentioned, there is need for there to be collaboration between universities and industry as well as with communities. But more importantly, it is commercialization and patenting of research outputs that will be the game changer. We cannot continue producing raw materials that are taken up by others who turn them into refined products that are then sold back to us at exorbitant prices. Collaboration between universities, industry and communities can be a powerful tool that can lead to adding value to those raw materials so that they can in turn fetch us higher prices necessary to transforming our country and the lives of our people. To realize this, universities have to start playing to their strengths. We cannot have every university offering the same programmes and courses and neglecting the value of setting themselves apart through specific programmes that make them stand out. You cannot be an expert when you stretch yourselves thin across multiple programmes. If you choose to focus on science and technology then stay focused on it instead of seeking to offer all manner of programmes outside such a focus. To this end I want to urge the Commission for University Education, through its work of regulating universities, to encourage those that demonstrate innovativeness, entrepreneurship and active linkages with industry and communities. Let such universities be given first priority through incentives by the government and bilateral partners.

Ladies and Gentlemen,

We already can see some of this process at work through support given to some universities by World Bank through the **African Centers of Excellence (ACEII**) programme, through universities being nominated as **UNESCO Chairs** for their outstanding work in **Science and Innovation**, and through Universities being supported as **Entrepreneurial universities** under the leadership of DAAD. There are also several universities that have received funding from **National**

Research Fund (NRF) based on their focus on the National Development Agenda. Many of these universities are represented at this conference. They will be telling their story about the projects they are carrying out. Let their stories motivate and inspire many others.

To further strengthen research in existing universities there is need to link universities with selected research institutes. Research institutes provide a strong foundation upon which to strengthen universities by combining research, teaching, community service, and commercialization. Creative approaches are needed to add graduate teaching functions to the institutes. Let universities use these institutes to train their post graduate students through provision of opportunities for practical skills development especially where facilities for such training are absent in universities. Links with Kenya Medical Research Institute (KEMRI), International Livestock Research Institute (ILRI), KARLO, International Centre for Insect Physiology and Ecology (ICIPE), and Kenya Industrial Research and Development Institute (KIRDI), among many others, is a sure way of enhancing capacity for our universities but also deepen our research to serve Kenyans.

Other opportunities for creating linkages with universities lie in public corporations and large infrastructure projects like the SGR, National Highways Construction, real estate development, to mention but a few. Some University Faculties should consider modelling the curriculum along full value chains of specific commodities. For example, universities located in proximity to sugar or cereal production regions should study the entire value chain of these industries. Such universities would help connect higher education to the productive sector through continuous interaction with businesses, Government, and communities.

Ladies and Gentlemen,

Private and public enterprises can also help expand our universities' capacity for technical training through in-house programs. Private firms can help consolidate training activities across industries to create dedicated training and research programs. With proper incentives such activities could contribute to the firms as well as to the wider economy. There a few notable examples of this work. Safaricom is supporting an academy at Strathmore University that offers a Master of Science degree in mobile telecommunications and innovation. The Manu Chandaria Foundation has set up a Business Incubation Hub at Kenyatta University and IBM has established research and training

centers in both Catholic and Kabarak Universities. Such collaborations not only tap into the expertise of our people but also help train new leaders in technology for our country and beyond.

Ladies and Gentlemen,

It is clear that the future of research and innovation lies in collaboration across many terrains. There is no doubt that this conference will provide you with an opportunity to start such collaborations through networking and building lasting relationships. It will also give you a glimpse into some of the innovative research projects going on in our universities and some of the areas that need more growth. I urge you not to see this as an end in itself, but rather as the beginning of a long scholarly engagement. Find ways to work together, to challenge each other and to learn from each other, because together you will do better for our nation and our continent.

This conference is best suited for that kind of work. Unlike many others where participants simply present papers for purposes of fulfilling individual requirements for promotion, this conference is organized to share practical results of institutional work that has involved multiple players. It is organized to provide the bigger picture of academic engagement which leads to consensus on how to advance an agenda that is of benefit to the wider community by engaging a large team instead of focusing on individual scholars.

Ladies and Gentlemen,

It is therefore my pleasure to declare the 2nd Biennial Conference on the State of University Education in Kenya officially open.

Thank you.

Influence of Technology Transfer from Universities to Manufacturing Firms' Innovative Performance

Isaac Muiruri Gachanja, Dr. Irura Nganga & Dr. Lucy Kiganane

Abstract

Technology Transfers (TT) from universities to manufacturing firms is important for enhanced Innovation Performance (IP) and ultimately improved competitiveness. However, TT is hampered by bureaucracy, inertia, inefficiency, cognitive dissonance and low activities in research and development. The purpose of this paper is to examine the relationship between TT from universities to manufacturing firms and their Innovation Performance. The study was anchored on Roger's (1995) innovation diffusion theory. The methodology used was a mixed-method research. The independent variable TT was measured in terms of technology spillover, networking and presence of accelerators and incubators within the locality of a firm. The dependent variable IP was measured through innovation output and innovation efficiency. Correlation design was used. The target population was manufacturing firms in Kenya. Stratified random sampling technique was applied. Primary data was collected through semi-structured questionnaires, interview schedules and checklists. Bivariate correlation and linear regression techniques were used to analyze the data. Cronbach alpha test for reliability and criterion-related validity was also used. Results indicated that there is a significant influence of TT from universities on innovation performance in manufacturing firms. It is concluded that universities are an important intermediary of technology transfer in manufacturing firms in Kenya for their improved IP and competitiveness. It is recommended that universities should create dynamic linkages with the industry and adopt an engaged learning approach in its programs to create greater and unique values for enhanced competitiveness and sustainable development.

Keywords; Technology transfer, Innovation performance, linkages and competitiveness

Introduction

The role of universities in education, research and knowledge dissemination is paramount in improving the Innovation Performance (IP) of firms because it leads to sustainable development and social-economic transformation of lives and societies. Universities are important partners in enhancing competitiveness in an economy. They are the engines of open innovation which mainly occurs through technology transfer (Secundo, Beer, Schutte & Passiante, 2017). Collaboration between the academia, industry and policymakers is crucial in technology transfer, but this is not always the case in developing countries.

Universities have been setting up Technology Transfer (TT) centers as agents of diffusion in an innovation system, but challenges still abound. Several studies have pointed out evidence of barriers and conflicts in TT (Bruneel, D'Este & Salter, 2010; Esquinas, Hermandez & Andia, 2016). Universities have deficiencies in TT to the industry which have impeded Innovation Performance (IP), especially in the manufacturing sector. They have higher bureaucracy, inertia and inefficiency than the industry (Lehrer, Nell & Gaerber, 2009). There also exist collaboration obstacles in terms of divergent attitudes between universities and industries which brings about disconnect between academic and business systems (Mascarenhas, Marques, Galvao & Santos, 2017). These impediments need to be resolved for enhanced competitiveness.

The industry too has their obstacles that obscure the flow of Technology Transfer. To begin with, the challenge of knowledge absorption capacity in manufacturing firms exists. Cruz-Gonzalez, Lopez-Saez, Navas- Lopez and Delgado-Verde (2014) have pointed out to cognitive dissonance in the acquisition of external knowledge and its assimilation in the industry. The situation has been contributed to by low activities in Research and Development (R&D) departments. Esquinas, Hermandez and Andia (2016) observed that there are few firms with robust R & D and sometimes the task of formalizing the linkage between private investors and universities is difficult. These challenges can be overcome by the removal of impediments, increased interaction in the National Innovation System (NIS), provision of resources and development of infrastructure.

There are few studies on how manufacturing firms in Kenya can leverage on TT from universities for improved IP. This study therefore aimed at investigating the benefits manufacturing firms accrue due to their linkages with scientific production emanating from universities and their influence on their overall performance among manufacturing firms. The study is motivated by the

fact that collaborations between the various partners in the NIS are perceived to be beneficial in promoting open innovation within an ecosystem (Garcia-Montijo & Perez-Soltero, 2018). Nevertheless, information about the effectiveness of cooperation is scanty despite the growing consensus about the importance of industry and academia linkages (Mascarenhas, Marques, Galvao & Santos, 2017). The findings of this study will provide more insight into how intellectual capital can be enhanced for greater productivity, growth and the prosperity of the nation.

The objective of the study is therefore to examine the relationship between TT from universities on IP in manufacturing firms in Kenya. The null hypothesis for the study is that; TT has no significant influence on IP of manufacturing firms in Kenya while the alternative hypothesis is that TT has a significant influence on IP of manufacturing firms in Kenya. The hypotheses were tested to arrive at conclusion.

Literature Review

The variables of the study which are TT and IP are each discussed separately. This is followed by an empirical review of the relationship between the two variables. The section provides an explanation of the study variable and a summary of previous studies on the relationship between Technology Transfer and Innovation Performance. Innovation is the process of utilizing opportunities emanating from research and converting the findings into new products, process, materials, methods, markets, business models and new enterprises. Innovation is considered to be a prime mover of human development and economic growth and is therefore worth the effort of contextualizing the role of researchers, universities, entrepreneurs and the government in fostering IP (Secundo, Beer, Schutte & Passiante, 2017). Its major contribution to firms is the improvement of competitiveness which enhances their survival and propels them to soar up beyond the turbulence brought about by the ever-changing dynamics in the business environment. However, innovation is a herculean task that requires diverse learning approaches and interaction with different parties. The effectiveness of innovation acidities can be evaluated through Innovation Performance.

Innovation performance is the degree to which firms develop new products, processes, markets and enterprises to increase their competitiveness. It results in the reduction of lead times, risk, cost and adoption of appropriate technology thus increased profitability (Secundo, Beer, Schutte & Passiante, 2017). It also enables firms to raise their market share, gain competitive advantage and

enhance their sustainable development (Babalola, Amiolemen, Adegbite & Ojo-Emmanuel, 2015). Innovation performance can be measured as the summation of the product of innovation output and innovation efficiency. Innovation outputs include; new products, processes, markets and enterprises (Andreeva & Kianto, 2011) while innovation efficiency is the increase in sales resulting from innovation activities (Spithoven, Frantzen & Charysse, 2010; Arvanitis, 2012). The two components were used to measure IP in this study.

Technology transfer is the process of transforming research findings into viable outputs that can be commercialized. Universities contribute to the innovation process by transferring technology and in research in collaboration with interested players, formalizing engagements with different parties, providing consultancy services, licensing of intellectual property rights, creating opportunities for continuous learning, dissemination of research findings and proving platforms for further interactions (Hsu, Shen, Yuan & Chuo, 2015). Successful technology transfer can lead to the creation of novel products, economic growth and development. Universities are therefore regarded as technology transfer catalyst, converter and translators of knowledge to usable form, science and technology impact amplifiers (Secundo, Beer, Schutte & Passiante, 2017).

The level of research, science and technology is the key determinant of IP of firms in an economy. It is difficult for firms to innovate in isolation and hence the need to collaborate with research institutes and institutions of higher learning (Greco, Gimaldi & Cricelli, 2015). Lazzorotti, Manzini, Pellegrini and Pizzurno (2013) assert that manufacturing firms that have established research collaborations improve their IP. The competitiveness of a firm is pegged on its ability to absolve technology and apply it to create value (Garcia-Montijo & Perez-Soltero, 2018). Technology transfer can, therefore, promote IP by increasing the competitiveness of firms.

It is also not tenable for universities to operate as an island of knowledge creation, but should seek partnership with business entities to disseminate their research findings. Universities are particularly the prime movers of technology in the value chain and their linkage with the industry is crucial for the competitiveness of a nation at the global level (Kelly, 2016). Universities are therefore agents of value creation in their societies. Furthermore, the forces of globalization point to the need of realization of the interdependence nature of multiple partners. It is imperative that

linkages between the industry and academia should be enhanced for greater technology spillover for the advancement of the economy.

2.1 Theoretical Underpinning of the Study

The paper is anchored on Roger's (1995) innovation diffusion theory. The theory stipulates that innovation that is geared towards addressing the needs of the society are embraced while those that appear alien to the communities in which the industry serves are rejected. The theory led to the development of the innovation-decision process model indicated in Figure 1.

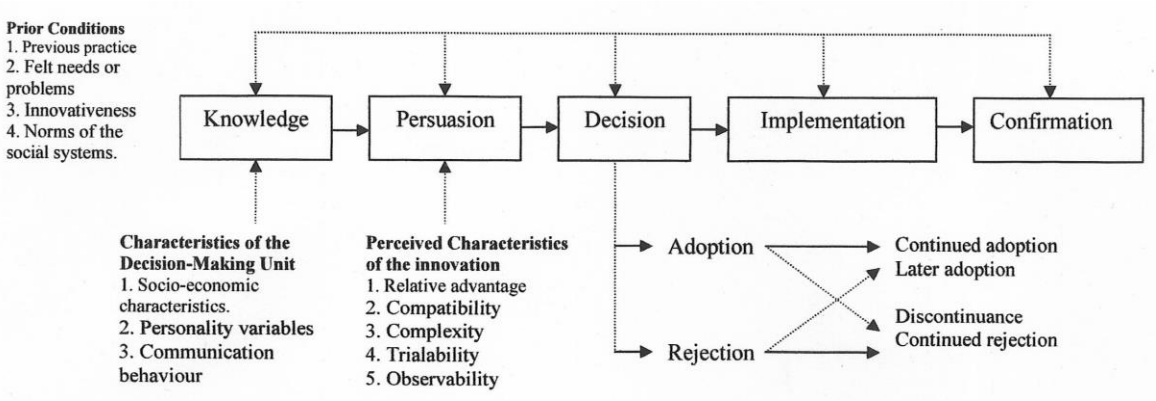

Figure 1: **The innovation-decision process model Source: Roger's (1995).**

The model indicates that new knowledge can persuade the industry players to make decisions in terms of adopting or rejecting new ideas. Embracing the new knowledge leads to its implementation and continuous improvement according to the needs of end-users resulting in incremental innovation.

The model ventilates on the three key functions of universities which are; training, research and community outreach or dissemination. The interactions between the three functions of universities are depicted in Figure 2.

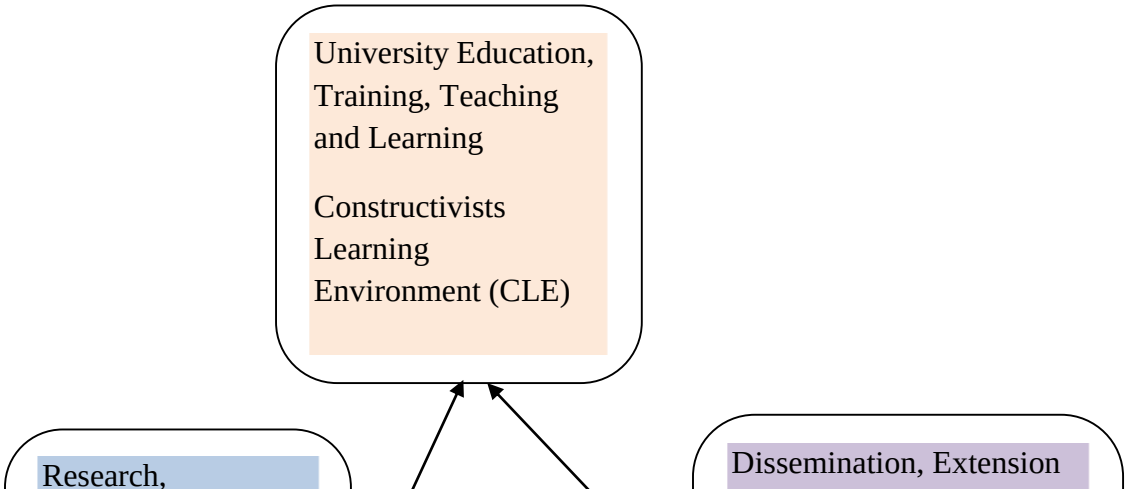

Figure 2: **Universities Role in Innovation and Technology Transfer Source; Authors (2018)**

The model shows that the ultimate goal of a responsive university to society is the dissemination of knowledge and research findings to the community. It demonstrates how universities can leverage on their staff and resources to develop intellectual capital which can be employed on transformative research that leads to the establishment of innovative enterprises that package intellectual product that result in technology transfer.

The Conceptual Framework for the Study

The models depict the association of universities and industry. Universities are expected to create an enabling environment where stakeholder (Society) participate in the knowledge generation through interactive problem-solving approaches in the real world, work field, laboratories or incubation centers to come up with innovative product development and market access needs through an appropriate technology transfer process that leads to social-economic growth and National development as depicted in Figure 3.

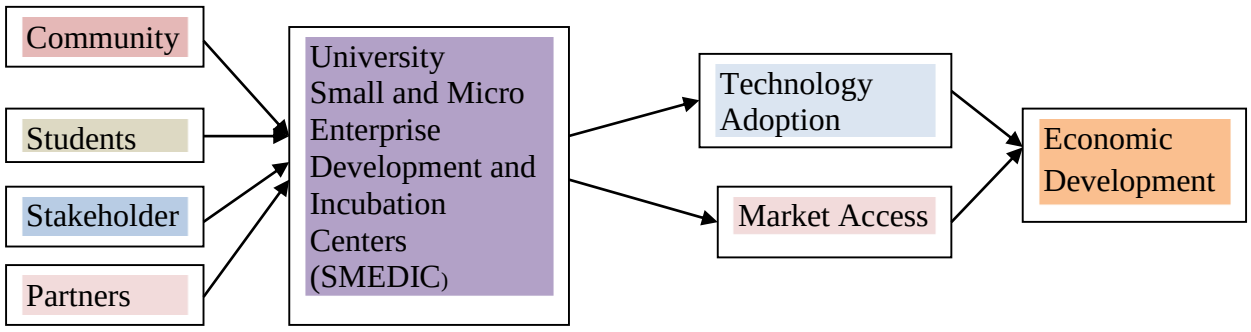

Figure 3: **Technology Adoption Facilitation Model (TAFaM) Source: Authors (2018)**

In this study, the influence of TT and IP in manufacturing firms is tested. Technology transfer is shown as the independent variable and was measured in terms of technology spillover, networking and presence of accelerators and incubators. Innovation performance, the dependent variable was measured in terms of innovation output and efficiency as indicated in the conceptual framework in Figure 4.

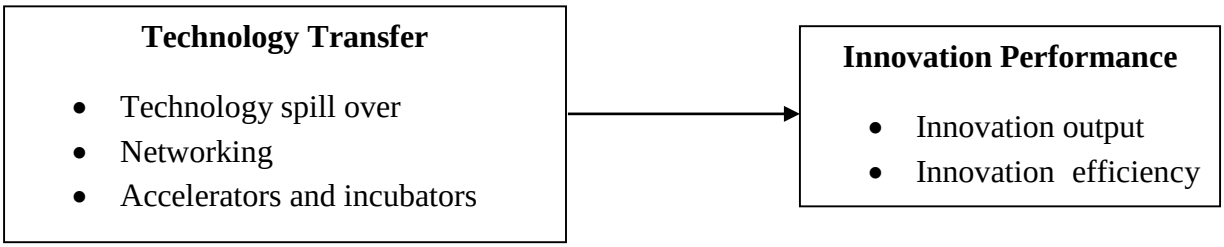

***Figure 4*: The relationship between technology transfer and innovation performance**

The conceptual framework shows the envisioned relationship between TT and IP in manufacturing firms. The relationship is tested in this study to derive conclusions.

Methodology

The methodology used was mixed-method research which is more comprehensive and provides a more holistic understanding of the phenomenon. The choice of the methodology was informed by both interpretivism and Positivism paradigms. Correlation design was applied because it is used to measure the relationships between variables (Creswell, 2014).

The target population was 493 manufacturing firms in Nairobi County. This is because Nairobi is the capital city of the country which forms a suitable cluster for assessing technology transfer and innovation performance. The city can attract talents, intense networking and deployment of resources. The sampling frame was the directory of Kenya Association of Manufacturers (2017/2018) which indicated 493 firms in the county as the registered members.

Stratified random sampling technique was used to ensure equal representation of the 12 sub-sectors in the industry and a sample size of 49 firms were obtained from the 493 manufacturing firms which represented a 10% sample size. Purpose sampling was then done to pick the head of

operations, innovation and marketing they are in charge of driving IP their firms. The sampled respondents were 147 as indicated in Table 1.

Table 1
Distribution of manufacturing firms in Nairobi County in the various subsectors

	Subsector	**Firms**	**Proportionate Sample (x/493)10% of 493**	**Respondents**
1	Building, mining and construction	17	2	6
2	Chemical and allied	65	6	18
3	Energy, electrical and electronics	41	4	12
4	Food and beverages	104	10	30
5	Leather and footwear	5	1	3
6	Metal and allied	52	5	15
7	Vehicle assemblers and accessories	37	4	12
8	Paper and board	58	6	18
9	Pharmacy and medical equipment	18	2	6
10	Plastics and rubber	54	5	15
11	Textile and apparels	25	2	6
12	Timber, wood and furniture	17	2	6
	Total	**493**	**49**	**147**

Source: Kenya Association of Manufacturers' (KAM) directory (2018)

Primary data was collected from sampled firms by use of semi-structured questionnaires, interview schedules and checklist. Data on technology spillover, networking and presence of accelerators and incubators from universities that were accessible to manufacturing firms measured TT. Innovation output and efficiency measured the IP of sampled firms. The outputs were in terms of new products, processes, enterprises and patents acquired while efficiency was measured in terms of percentage increase in sales as a result of innovation activity.

Semi-structured questionnaire and structured interview schedules were used to collect data. Interview schedules were utilized to collect data from key informants who were the person representing the top management. The observation checklist was used to identify the presence of TT and IP in a firm.

Bivariate correlation and linear regression techniques were used to analyze the data. The reliability of the research instrument was put to test to confirm its appropriateness. The Cronbach's Alpha approach was used to test for reliability which gave a value of 0.835 which is greater than 0.7. This implies that the data collection instruments were reliable. It means that the data collection

instruments were stable and consistent. The validity of the instruments was tested using the criterion-related validity or instrument validity. This was applied by comparing the data in the questionnaire with the interview schedule to determine the accuracy of data collected in representing TT and IP. The Variance Inflation Factor (VIF) was used to test for Multicollinearity.

The research permit was obtained from the National Commission for Science, Technology and Innovation. The researchers also sought consent from the identified firms and the research instruments were only administered to those who were willing to participate in the survey.

Findings and Discussion

The response rate was at 81.6% because 120 respondents out of 147 were cooperative. The majority of the respondents had over 10 years of experience in the manufacturing firms as indicated in Figure 5.

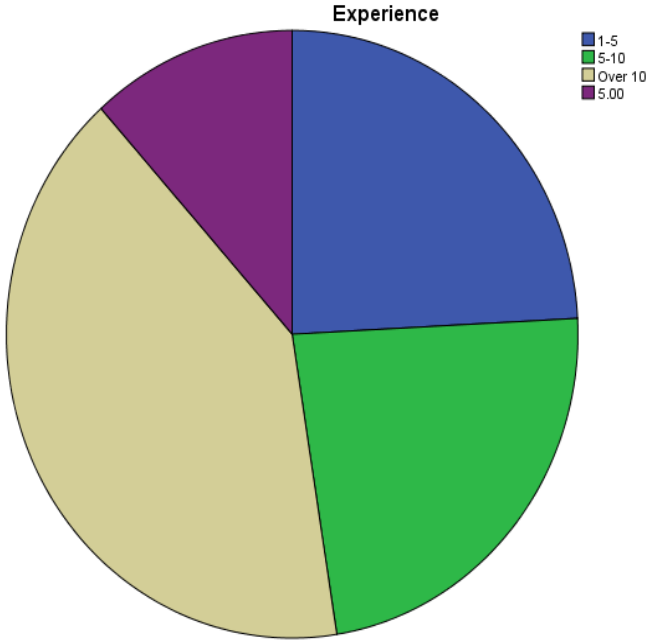

Figure 5: **The work experience of the respondent in manufacturing firms**

This implies that manufacturing firms consider work experience before one is promoted to head the operations, innovation or marketing section. It therefore means that work experience is valued in manufacturing sector.

The composite indices for TT and IP were arrived at after aggregating the respondent's scores on the parameters of each the variable. The summation of innovative products, process, enterprises and patents acquired for the last three years was done and then the sum was multiplied by the percentage sales growth rate brought about by innovation for the same period to form the variable IP.

Descriptive statistics were conducted to find the distribution of the parameters for measuring IP. This was done by the analysis of mean, standard deviation, variance and range. The highest mean, standard deviation, variance and range was in the number of increased new products at 4.5667, 2.76756, 7.659 and 7 respectively as indicated in Table 2.

Table 2
The variance of the parameters of Innovation Performance

		Number of increased new products	Number of new enterprises	New innovation processes	Number of patents acquired	Sales growth rate
N	Valid	120	120	120	120	120
	Missing	0	0	0	0	0
Mean		4.5667	1.4750	2.0750	2.2667	.3072
Std. Deviation		2.76756	1.38396	1.84328	1.77628	.21531
Variance		7.659	1.915	3.398	3.155	.046
Range		7.00	4.00	5.00	5.00	.53

This implies that there was a wide variety of new products that were produced compared to other forms of novelty. It meant that new products were the most notable form of innovation in manufacturing firms in Kenya.

The scores on technology spillover, networking and availability of accelerators and incubators in the firm's locality from each of the respondents from the Likert scale were captured and coded. The scores were then added up to form the variable TT. The highest mean, standard deviation, variance and range were in technology spillover at 11.2583, 2.92912, 8.580 and 8 respectively as indicated in Table 3.

Table 3
The variance of the parameters of Technology Transfer

		Technology spillover	Dynamic networking in the industry	Presence of incubators and accelerators
N	Valid	120	120	120
	Missing	0	0	0
Mean		11.2583	3.7583	3.6750
Std. Deviation		2.92912	1.07684	1.09362
Variance		8.580	1.160	1.196
Range		8.00	3.00	3.00

This implies that there was a wide variety of technology spillover than other forms of TT. It meant that technology spillover was the most notable form of TT in manufacturing firms in Kenya. The latent variables of TT and IP were then correlated to establish the relationship between them. The correlation coefficient of TT and IP was 0.894 as indicated in Table 4.

Table 4
Correlation between Technology Transfer and Innovation Performance

		Technology	IP
Technology	Pearson Correlation	1	.894**
	Sig. (2-tailed)		.000
	N	120	120
IP	Pearson Correlation	.894**	1
	Sig. (2-tailed)	.000	
	N	120	120

The Pearson correlation value of 0.894 is near 1 meaning a strong relationship between TT and IP exists. The value is also positive implying that the two variables move in the same direction hence they are correlated. This implies that as technology transfer from the universities increases so does innovation performance and vice versa among manufacturing firms in Nairobi County. The findings concur with Kande et al., (2017) who found that universities play a crucial role in promoting the innovation performance of firms in Kenya. The findings are also in tandem with other studies conducted in other parts of the world such as; Secundo et al., (2017), Garcia-Montijo and Perez-Soltero (2018). However, the findings contradict those of Cruz-Gonzalez et al., (2014) and Thu et al., (2018) who found that not all external collaboration influences innovation but only

collaboration with the internal supply chain. It is, therefore, necessary to constantly evaluate the benefits of external collaboration.

The analysis of variance between the two variables was also conducted to test the hypothesis which confirms a significant influence as shown in Table 5.

Table 5
The Analysis of Variance Between Technology Transfer and Innovation Performance

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1664.931	1	1664.931	469.614	.000[b]
	Residual	418.347	118	3.545		
	Total	2083.278	119			

The p-value is zero which is less than 0.05. The value led to a rejection of the null hypothesis and consequently the acceptance of the alternative hypothesis thus TT from universities has a significant influence on IP in manufacturing firms.

Linear regression was also carried out to demonstrate the extent to which technology transfer from universities influences IP of manufacturing firms. The results indicate a huge proportion of change in IP is brought about by TT. The R square value was 0.799 which is equivalent to about 80% as indicated in table 6.

Table 6. The extent of contribution of Technology Transfer on Innovation Performance

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.894[a]	.799	.797	1.88290

This implies that 80% of IP is brought about by TT. Technology transfer should, therefore, be enhanced to increase the IP of manufacturing firms.

The relationship between TT and IP can be depicted through a model. The type of data for the dependable variable is continuous and therefore a linear regression model is suitable. The model is developed through the results of linear regression coefficients between TT and IP. The model shows a VIF value of one, a constant value of -9.389 and TT coefficient value of .753 as indicated in Table 7.

Table 7

The Variance Inflation Factor and Coefficients of Variables in Model Formulation

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-9.389	.672		-13.978	.000		
	Technology	.753	.035	.894	21.671	.000	1.000	1.000

The resultant value of VIF was one implying less or no Multicollinearity between the TT and IP. This means that the study accurately assesses what the researcher attempted to measure. The value of the constant is -9.389 while the coefficient of TT is 0.753. The relationship between TT and IP can, therefore, be modeled as; $Y = 0.753X - 9.389 + e$: Where Y is the value of IP and e is the error term. The model further implies that the innovation performance curve intercepts the technology transfer from below at a value of -9.389. This implies that when TT is zero the IP is negative 9.132. This means that when there is no technology transfer, there is retardation in IP.

The limitations of the study are that it was conducted in the manufacturing sector only which excluded other sectors and therefore the impact may not be generalized to the entire economy. The study was also localized in Nairobi County excluding other areas that are geographically dispersed across the country. The study also focused more on TT from universities. Cruz-Gonzalez et al., (2014) observed that collaboration among firms in the same industry is more beneficial than TT from universities. The other limitation is that causality cannot be inferred in this study as observed by Thu et al., (2018) because of the cross-sectional design employed.

5.1. Conclusions and Recommendations

The findings reveal that technology transfer from the universities has a significant influence on IP of manufacturing firms. It is, therefore, necessary to encourage university and industry linkages for greater growth and development. The appropriate measures should, therefore, be put in place to foster such interactions.

It is recommended that firms should redefine their boundaries to allow technological flow and attract external knowledge for their improved performance. Universities, on the other hand, should

transform their networking to offer an opportunity for interaction with the industry by setting up robust and entrepreneurial technology transfer centers, incubation centers, and deliberately create a Constructivists Learning Environment (CLE) that anchors problem based learning (PBL) to foster dissemination of knowledge to the business community. The government should also develop and implement policies and funding mechanisms that ensure quality research that respond to the issues affecting society. There is also a need to develop and promote a deeper interaction within the National Innovation System and increase the capital outlay in technology and capacity for greater competitiveness of the economy. The paper recommends further research on the benefits that accrue to the universities apart from fulfilling their community outreach obligation, in their efforts to promote technology transfer in the society.

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University Industry Linkages: Establishing Relevance of University Courses in Kenya

Kyule Alexander, Mile Justus, Maureen Kangu & Indara Celine

Abstract

There has been a lot of concern in the East African region and Kenya in particular about the relevance of courses offered by universities to the market needs. The Industry asserts that the courses on offer do not meet their demands, yet the universities argue that the choice of their courses is need driven rather than populist driven, which aim at making money. While in the developed world there are clear cut structures on varsity industry linkages, it is not the case in Kenya. In addition, very few in the industry come out to support varsity courses and research to determine course relevance in the market, since they seek to realize benefits in the short run. This study therefore sought to establish extent to which universities in Kenya engage the industry in the development of courses to offer. The study made use of the descriptive survey design. The target population comprised of 365 members of curriculum development committees selected from 74 universities in Kenya. Census sampling was adopted. Questionnaires were used to collect primary data. Data was analyzed using descriptive statistics. The study found that there was awareness of the need for universities and industry to collaborate in determining need driven courses. In addition, although there are well laid down structures to enhance that, the implementation of the

process failed due to lack of adequate financing and in some cases lack of top management support. The study concludes that there is need for universities and industry to work very closely to offer relevant courses that can enhance Kenya's economic growth and development.
Key words: Universities, Industry, Relevant Courses, Collaboration

Introduction

A good curriculum should capture the needs of the market. Curriculum success is thus realized through the quality of learning achieved by students, and how effectively they use learning for practice and meet market employment needs (Kuh, Kinzie, Schuh, & Whitt, 2011). In the developing world and Kenya in particular, there is an acute mismatch between employer demands and job applicants' skills (World Bank, 2013). This requires that workforce training needs to conform to the skills and competencies required for employment.

In order to produce a well-equipped and professionally skilled man power that could fit the market, quality of curriculum should get great emphasis of educators, authorities and industry (Stabback, 2016). Malaysia, which expects to join the developed countries status by 2020, realized that the Research and Development (R&D) activities conducted in universities had a significant function in driving firm-level innovations. They thus implemented policies since the early 1990s to stimulate R&D collaboration between universities and industry (Salleh & Omar, 2013). The Knowledge Transfer Partnership (KTP) program was thus introduced to enhance the transfer of expertise and research findings through innovative projects undertaken jointly by faculty members and their business partners from the industry. In addition, industrial-based trainings programs to enhance the practical knowledge, business skills, and employability of graduates was also put into practice (Salleh & Omar, 2013).

There is therefore a need for collaboration between university and industry in curriculum development process. This will help in producing skilled graduates for the work market (World Bank, 2013).

Problem Statement

University-industry collaboration is a necessity that seeks to ensure that the relevant and the right number of graduates join the market. This match should start right from the point universities develop courses to offer. It is worth noting that in the developed world, this is largely achieved since there are clear cut structures on varsity industry linkages. In addition, there is high level support for universities to collaborate with industry (Freitas, Marques, & e Silva, 2013) from the governments and the industry itself.

In the developed world, organizations have been working together with research institutions and universities to come up with areas of need (Ivascu, Cirjaliu, & Draghici, 2016) Evidence of such collaborations in Kenya is minimal (Daud, Abidin, Mazuin, & Rajadurai, 2011). Unfortunately, a large number of graduates in the developing world fail to get jobs, yet some industries lack qualified staff, which can be attributed to poor industry university collaboration on needs assessment. The Commission for Higher Education (CHE) workshop held in Nairobi in 2000 on university - industry linkages, observed that there has been little, if any, attempt to understand university - company linkages in developing countries such as Kenya (Abagi et al., 2005). This can be seen as the reason why some courses on offer by universities fail to meet the market needs. This study thus sought to establish the extent to which universities in Kenya engage the industry in determining the industry relevant courses to offer.

Objective

To establish the extent of university-industry collaboration in university curriculum development in Kenya.

Literature Review

The Competency Model

The competency model defines an amalgamation of competencies that enhance effectiveness in performance at work (Dainty, Cheng, &Moore, 2005). Competency models enable the transferring of knowledge between industry and academia (Tessema & Abejehu, 2017). They support the development of curricular through determination of skills needed in work, providing content that is used to build up teaching resources, and provision of business oriented framework from which teaching objectives are determined (Laurillard, 2013).

Curriculum development

Curriculum development and review in Kenyan universities is largely the role of university faculty members. This is coordinated through their respective departments (Owuor, 2012). In an event external expertise is needed, a specialist is hired in accordance with the university policies. The teaching staff in departments identify areas in need of developing a new curriculum or point out areas that require review. This is then escalated to the Head of Department where a meeting is held to brainstorm on these needs. This is further taken to the School Board, Deans Committee, and eventually the Senate which approves the new curriculum or the amendments; or even disapproves it (Cheserek, 2010).

In Kenyan Universities, curriculum development is conducted by each university individually (Owuor, 2012). A number of challenges have been found to face the Kenyan higher education sector, including lack of quality faculty (Sifuna, 2010). A sound curriculum development process entails proper planning, identification of realistic learning outcomes, development of effective measures to determine the achievement of learning outcomes, and the use of measurement data to determine improvements (Hussain, Dogar, Azeem & Shakoor, 2011).

Additionally, there is need to involve all the stakeholders, so as to get feedback from them. Such stakeholders include students, recent graduates, industry/employers, faculty, the community, and the government. This will help ensure that the courses of offer capture the market needs. Stakeholder involvement makes the curriculum development process decisions made in accordance to factual data (Nyangau, 2014).

University-industry linkages

It is notable that the industry may not have all the competencies. Therefore, to meet these requirements, collaboration between two or more partners is necessary (Ivascu, Cirjaliu, & Draghici, 2016). In this regard, collaboration of industry with universities helps the industry in researching the problems whose solutions cannot be found alone. This is a plus for the industry; such that we may we may look at universities as partners for industries. Research has it that organizations collaborating with universities tend to have superior output than organizations that fail to collaborate (Salleh & Omar, 2013). In addition, reducing costs of research and development, making use of synergetic approaches, riding on different collaborators reputation, producing quality products at a competitive cost, to mention just but a few, constitutes of the benefits realized by the industry (Oyelaran-Oyeyinka, & Adebowale, 2017).

It has been found that university and organizations are motivated by different reasons to collaborate. University researchers tend to collaborate with organizations in order to advance their research interests, and not so advance industrial development (Freitas, Clausen, Fontana, & Verspagen, 2011). More specific, they are focused on funding for their research, secure funds for graduate students and lab equipment, and to test the practical application of their theory and research. However, for success of the collaborations to be achieved, there is a need to permit both parties to achieve their specific goals. This means that achieving ones' goals enhances the achievement of the other's goals (Koigi, Kiragu, Marwa & Theuri, 2018).

University-industry linkages and curriculum development

The collaboration between university and industry is a subject of interest because of the high degree of innovation and economic output and growth that is realized. Partnership in education development between the universities and industry has been perceived as mutual relationships between the two players (Koigi, Kiragu, Marwa & Theuri, 2018).Incorporation of university-industrial linkages in the university academic programmes is one ways of way through which the universities are responding to change to maintain a competitive advantage (Council, 2015).

Most developing countries are faced with a glaring gap between industry and academics. This has made universities and research academies to seek ways to align educational content to market

needs (Starkey and Madan, 2011). This therefore requires the curriculum developed to constitute both theory and practicals. In order to produce skilled graduates, there is need for strong collaboration between university and industry. It is notable that the cooperation between the university and the industry is a growing trend. However, collaboration of these two key parties in curriculum development process has not been realized on the ground as it is portrayed on paper. In many cases, the collaboration is never realized, especially at the stage of curriculum development. The collaborations tend to occur in line with the existing curriculum rather than right from curriculum development (McKernan, 2013).

In the UK, policy-makers have encouraged universities to foster links with the users of knowledge by facilitating its transfer. This has been realized through the commercialization of academic knowledge. It entails patenting and licensing of inventions in addition to academic entrepreneurship. It is worth noting that commercialization generates academic impact because it constitutes immediate, measurable market acceptance for outputs of academic research. (Ranga, & Etzkowitz, 2015). Thus, many universities have established specialized structures, such as technology transfer offices, science parks and incubators which have led to the creation of supportive internal rules and procedures.

Here in Kenya, the Technical and Vocational Education and Training Authority (TVETA) institutions have made the move to enhance linkage with industry in order to develop relevant curriculum (Dunbar, 2013). This curriculum is meant to assist students in the institutions to quickly adjust to the fast changing work environment. Existing linkages included in areas such as research, staff exchange, student attachments, equipment sharing and instructors industrial experiences. However, challenges may arise as in the case of Ghana, where TVET Linkages with industry in terms of input for curricula development were found to be weak resulting in mismatches of supply and demand of skills (Darvas, & Palmer, 2014).

The benefits of the University industry linkages in curriculum development cannot be ignored. Done successfully, the learning outcomes will be more relevant. Relevant courses to the industry will be designed and improved quality of educational programmes will be realized. In addition,

the output (graduates) will be better trained while economic growth in the country will no doubt be boosted Guimón, 2013).However, industry tends to focus much on profitability organizations such that some of the collaborations do not seem to be lucrative, or in other cases it takes very long. This is because collaboration is inherently expensive and is realized in the medium to long run, while organizations seek short-term results and clear contributions to current business lines (Geiger, 2006). In most cases, universities tend to be interested in courses that will bring in more students, even if they are need driven or not. In addition, in some cases, the university policies and procedures are not clear cut and tend to be poorly implemented owing to organizational politics. Since public universities rely mostly on government funding, inadequate funding makes the not so popular courses unlikely to survive (Ajadi, 2010).

The role of the industry in curriculum development cannot be overstated. According to a World Bank report (2013) on University- industry collaborations, industry is critical. Through the collaboration, the industry is able to enhance skills development, the generation, acquisition, and adoption of knowledge (innovation and technology transfer), and the promotion of entrepreneurship (start-ups and spin-offs). In the same breadth, Subramonian and Rasiah (2016) assert that the industry's contribution to development of curricula is important for the all-round development of students. They recommend the following areas in which industry can be helpful in curriculum development; involvement in course design, donation or resources, placement of industry staff as part time professors on the job training opportunities, among others.

However, it should be noted that there is a wide gap between the motivation, scope and purpose between academic research and industrial research and production. This complicates the linkages and therefore the need to ensure the policy makers are able to fill the gap in order for the intended objectives to be realized (Oyelaran-Oyeyinka, & Adebowale, 2017).

Methodology

The study made use of the descriptive survey design. The target population comprised of 365 members of curriculum development committees from selected from 74 universities in Kenya. Census sampling was adopted. Questionnaires were used to collect primary data. The questionnaires comprised of a five point Likert scale, with values strongly agree, agree, neutral,

disagree and strongly disagree. Three hundred questionnaires were returned duly filled. A pilot test was carried out where ten questionnaires were given out.

Table 1

Pilot test results

No	Issue	Alpha value	Remarks
1	Industry involvement in curriculum development	0.821	Reliable
2	Adequacy of resources to support collaboration	0.755	Reliable
3	Awareness of stakeholders on the need for collaboration	0.830	Reliable
4	Top management support	0.765	Reliable
5	Presence of University-industry linkages structures	0.758	Reliable
6	Compliance to the structures	0.779	Reliable

Source: Researcher (2019)

All the six items under study, as shown in Table 1 had an alpha value of more than 0.75 which is within the accepted range of reliability (Peters, 2014). On content validity, peers made recommendations, and the questions were found to be able to give the expected answers. This means that the questions were well structured and well understood devoid of ambiguity. Data was analyzed using descriptive statistics.

Findings

The findings on the extent of university-industry collaboration in university curriculum development in Kenya, are captured in Table 2.

Table 2

University- Industry linkages
Source: Researcher (2019)

No	Issue	Strongly agree %	Agree %	Neutral %	Disagree %	Strongly disagree %	Likert Mean
1	Industry involvement in curriculum development	26	20	5	24	27	2.6282
2	Adequacy of resources to support collaboration	14	15	10	30	31	2.4230
3	Awareness of stakeholders on the need for collaboration	24	27	4	24	21	3.9034
4	Top management support	28	29	15	23	15	3.879
5	Presence of University-industry linkages structures	34	27	7	18	14	4.8076
6	Compliance to the structures	15	15	8	37	25	2.6410

A majority of the respondents, 51% (24%; 27%) disagreed that there was industry involvement in curriculum development. This implies that universities did not involve the industry adequately in the development of curricula. This had a mean of 2.6. In the same breadth, a majority 61% (30%; 31%) disagreed that there were enough resources at the universities to support the collaboration. This could explain why the involvement of the industry was minimal. However, the top management was found to be supportive of the collaboration in curriculum development with 28% and 29% strongly agreeing and agreeing to that the Top management was supportive. This had a mean 3.9. The study also found that there was awareness of the need for universities and industry to collaborate in order to determine the need based courses to be offered (51%). In addition, it was found that there were well laid down structures to enhance the process through the linkages, with 34% and 27% having strongly agreed and agreed respectively. However, a minority admitted to there being compliance to the structures, with a cumulative 30% (mean 2.6) agreed to there being compliance to the structures. This is likely to affect the collaboration in the curriculum development process in addition to lack of industry involvement.

Discussions and implications for theory and practice

The study sought to establish the extent of university-industry collaboration in university curriculum development in Kenya. The study was a descriptive survey design which employed census sampling. The findings indicate that there was awareness of the need for universities and industry to collaborate in determining need driven courses. In addition, although there are well laid down structures to enhance that, the implementation of the process failed due to lack of adequate financing and in some cases lack of top management support.

Previous studies indicate that to fill the gap between industry and academics, there is need to align educational content to market needs (Starkey & Madan, 2011), thus the need to have a curriculum developed to constitute both theory and practicals. In addition, emergent studies emphasize on the need for strong collaboration between university and industry (McKernan, 2013). This concurs with Guimón (2013) who emphasizes on the need to have relevant courses to the industry needs since they improve the quality of educational programmes, such that the output will be better graduates to deal with market needs. A good case in practice is Malaysia which appreciates Research and Development activities conducted in universities and thus implemented policies

since the early 90s to stimulate collaboration between universities and industry (Salleh & Omar, 2013).

Despite this, challenges abound where the motivation of the industry and university on curriculum development tend to differ. According to Geiger (2006), industry tends to focus much on profitability such that some of the collaborations do not seem to be lucrative to them. In addition, universities tend to be interested in courses that will bring in more students, even if they are need driven or not.

1.1 Conclusion

From the findings, it can be concluded that university industry collaboration on curriculum development is minimal. In addition, the resources to enhance the university – industry collaborations are inadequate, despite the top management at the university being supportive of the collaboration. In addition, the expected awareness of the need of university – industry collaboration in curriculum development among the stakeholders was there. On the presence of structures to enhance university industry collaboration, the study concludes that they exist; however, there is no compliance to the existing structures.

1.7 Recommendations

The study recommends that adequate funding is needed for both universities and industry to ensure existing collaboration structures in universities are enhanced. In addition, the university and industry ought to ensure that the collaboration in curriculum development is realized since it is beneficial to both. The researcher further recommends further research should be done on collaboration of universities and industry in Research and development.

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Planning for Equitable Distribution of Out-Patient Health Facilities. A Case Study of Homabay County, Kenya

Antony Ondiwa Okundi

Abstract

Agenda 2063 envisions the capacitated coverage of Africans to health services. This has inspired the affiliated states to formulate policy frameworks to facilitate its fruition. For instance, Kenya recently embraced the Big Four agenda which champions for the realization of universal health care as one of its deliverables. Since colonization, distribution of health facilities have registered urban dominance and political manipulations, therefore the rural populace have had to succumb to long distances to consume quality health service. This study demonstrates the utility of Geographical Information Systems (GIS) in the achievement of equitable distribution of health facilities using Homabay County of Kenya as a case study. The study adopted a multi-criteria evaluation technique in the establishment of various sites for the location of health facilities. This progressed through the establishment and weighting of factors considered in site selection for health facilities. This facilitated the building of location-allocation model to aid in the determination of the optimal location of the facilities by exploiting access model (motorbike) as a visual intelligence of health coverage. The model leverages the establishment of additional optimal locations for considerations to achieve equitable distribution of health facilities. This study authenticates the utility of GIS in facilitating the realization of Universal Health Coverage.

Keywords: Geographical Information System; Multi-criteria Evaluation; Network Analysis; Location-Allocation Model; Spatial analysis

Introduction

Spatial distribution of community facilities in space is a significant barometer of the level of service provision. Gaps in the health service provision are manifested by the differential locations of patients and the health center. This may be translated into two geographical perspectives of healthcare service namely accessibility and utilization (Mokgalaka, 2014). In Africa, governments have been entrusted with the daunting task to offset spatial accessibility bottlenecks faced by their citizens and to achieve social and spatial equity in the distribution of health services (Samuel & Adagbasa, 2014).

Location-allocation models are relevant to the contemporary challenges by designing a platform for examining service accessibility enigmas, assessing the efficiency of previous capacitation and current capacitation and provides an inventory of antidotes to either prescribe more viable services or to revamp the existing systems (Rahman & Smith, 1999 and Ouyang et al.,2016).The models are configured to correspond to three major levels of planning decisions namely the location of facilities, demand allocations to respective facilities and the resource capacity of the facilities (Lin, 2014).

Identification and finding of best locations for a particular facility or land use are significant activities encountered by the public and private organizations. The various types of location models include but not limited to P-median problem, and p-centre problem, as well as the location set covering problem (LSCP), the maximal covering location problem (MCLP), the maximal service area problem (MSAP) and Capacitated Maximal Covering Location Model (CMCLP) (Owen & Daskin, 1998, Indriasari et al., 2010, and Shariffa et al., 2012). Optimal site selection can be achieved by network models namely minimize impedance, maximize coverage, maximize capacitated coverage, minimize facilities, maximize attendance, maximize market share and target market share (Environmental Systems Research Institute(ESRI), 2016).

Minimize Impedance Problem: Also known as the P-Median Problem (Hakimi, 1964).The primary objective is to determine appropriate locations for a number of specific facilities so that the total sum weighted costs between demand points and solution facilities is minimized. Contingent to its ability to minimize costs and maximize efficiency the overall costs are automatically reduced hence appropriate in locating retail stores, libraries, schools, hospitals and other private sectors. *Maximize Coverage Problem*: As developed by Church and Reveille, this model seeks to establish the optimal locations for a fixed number of facilities that service as many demands as possible within the prescribed impedance

cut-off. This model is frequently applied in locate facilities in the public sector to locate emergency service facilities e.g. fire stations, police stations and ERS centers. *Minimize Facilities Problem*: This model is similar to Maximize Coverage Problem but with the exception of the methodology of allocation solely depends on the solver. Is appropriately applied in the location of fire stations, ambulances, police and even bus stops. *Maximize Attendance Problem*: As developed by Holmes in 1972, the principal objective is to maximize the number of demand points that the facility can service with a specified impedance cut-off. The assumption is that the probability of interaction between the facility locations and the demand locations decreases with an increasing distance. *Maximize Capacitated Coverage Problem*: This model locates facilities such that as many demand points as possible are allocated to solution facilities within the specified impedance cut-off. The assumption is that all the weighted demands assigned to a solution facility don't exceed the facility's service capacity. *Maximize Market Share Problem*: This model seeks to maximize the allocation of demand points to a facility in the presence of other competitors. The total market share is calculated by adding all demand weights for valid demand points. *Target Market Share Problem*: The objective is to select the minimum number of facilities necessary to capture a specified percentage of the total market share in the presence of other competitors (ESRI, 2016).

The following are the research objective that this paper will address;

i. To perform a suitability analysis for situating a health center.
ii. To assess the suitability of the current health facilities.
iii. To model the spatial coverage of the existing health facilities.
iv. To propose a Data driven-fact based analysis to redress the strained access in Homabay County.

Study area

Homabay County lies between latitude 0^{o} 15' South and 0^{o} 52' South and between longitudes 34^{o} East and 35^{o} East and occupies an area of 4,267.1 Km^2 inclusive of its Lake Victoria waters which on its own covers an area of 1,227 km^2. The County also comprises 8 sub-counties (Kasipul, Kasipul Kabondo, Mbita, Homabay Town, Rangwe, Dhiwa, Karachuonyo and Suba) with a population of 963,794 (Government of Kenya, 2009). Assuming a geometric formula of population projection with an annual growth rate of 2.7, the current population in 2019 is approximately 1,114,905 persons.

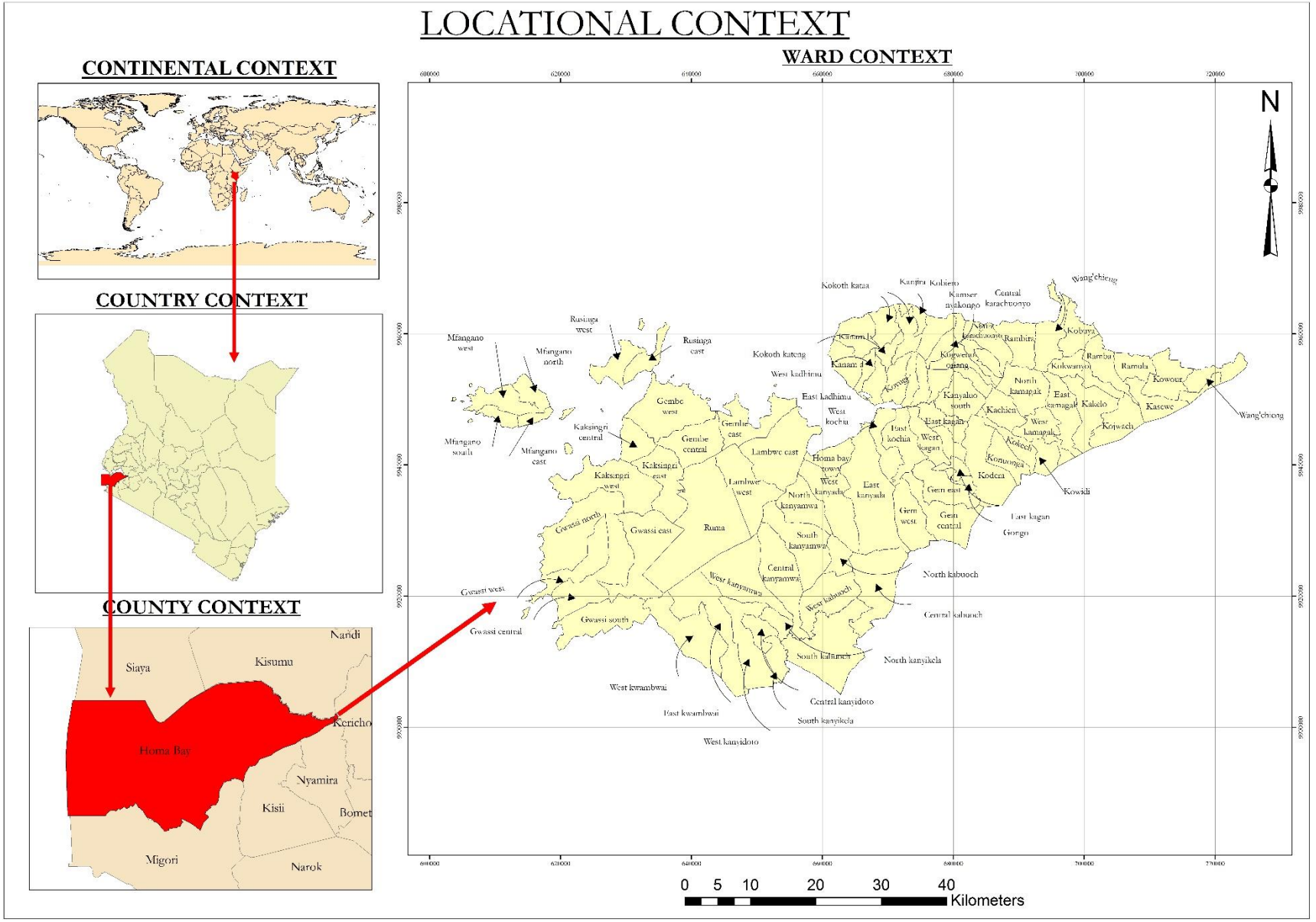


Figure 1: Locational context of Homabay County

Methodology

Data source

A geodatabase was designed to facilitate the spatial and network analysis of Homabay County. It also enabled the housing of vector and raster datasets such as schools, health centers, villages, roads, forests, wetlands, streams, protected areas, administrative areas, Lake Region and a Digital Elevation Model.

Table 1

Data Source Matrix

DATA NEEDS	DATA SOURCE
Schools	Ministry of Education & Digitization
Health centers	ILRI and Ministry of Health
Villages/Homesteads	International Livestock Research Institute(ILRI)
Roads	Kenya Roads Boards Authority (KRB)
Administrative Boundary	Survey of Kenya
Forests	World Resource Institute (WRI)
Wetlands	WRI & Digitization
Riparian e.g. rivers, lakes	WRI & Digitization
Digital Elevation Model	USGS

Procedure

To achieve the predefined objectives, this paper adopted a primarily analytical based approach using Geographical Information System (GIS). The analysis was further splintered to spatial and network analysis. The Spatial analysis involved the preparation of three models; suitability and restriction models that were overlaid to yield the most suitable sites for the establishment of health centers.

3.2.1 Suitability and Weighted Site Selection

This is a GIS-based analysis that encompasses the exposure of most suitable or best sites to locate a facility or a function. Suitability techniques inform on different stakeholders such as environmental managers and planners to understand, assess and conceptualize the reciprocating factors of location, development actions, and environmental elements (Collins, Rushman, & Steiner, 2016). Site selection analysis must, therefore, incorporate diverse criteria and parameters that interplay to influence the best choice of location. The qualified parameters chosen are then channelled through a chamber where

reclassification and weighting are conducted to rank raster cells using a measurement scale and designate a value index to each relevant parameter.

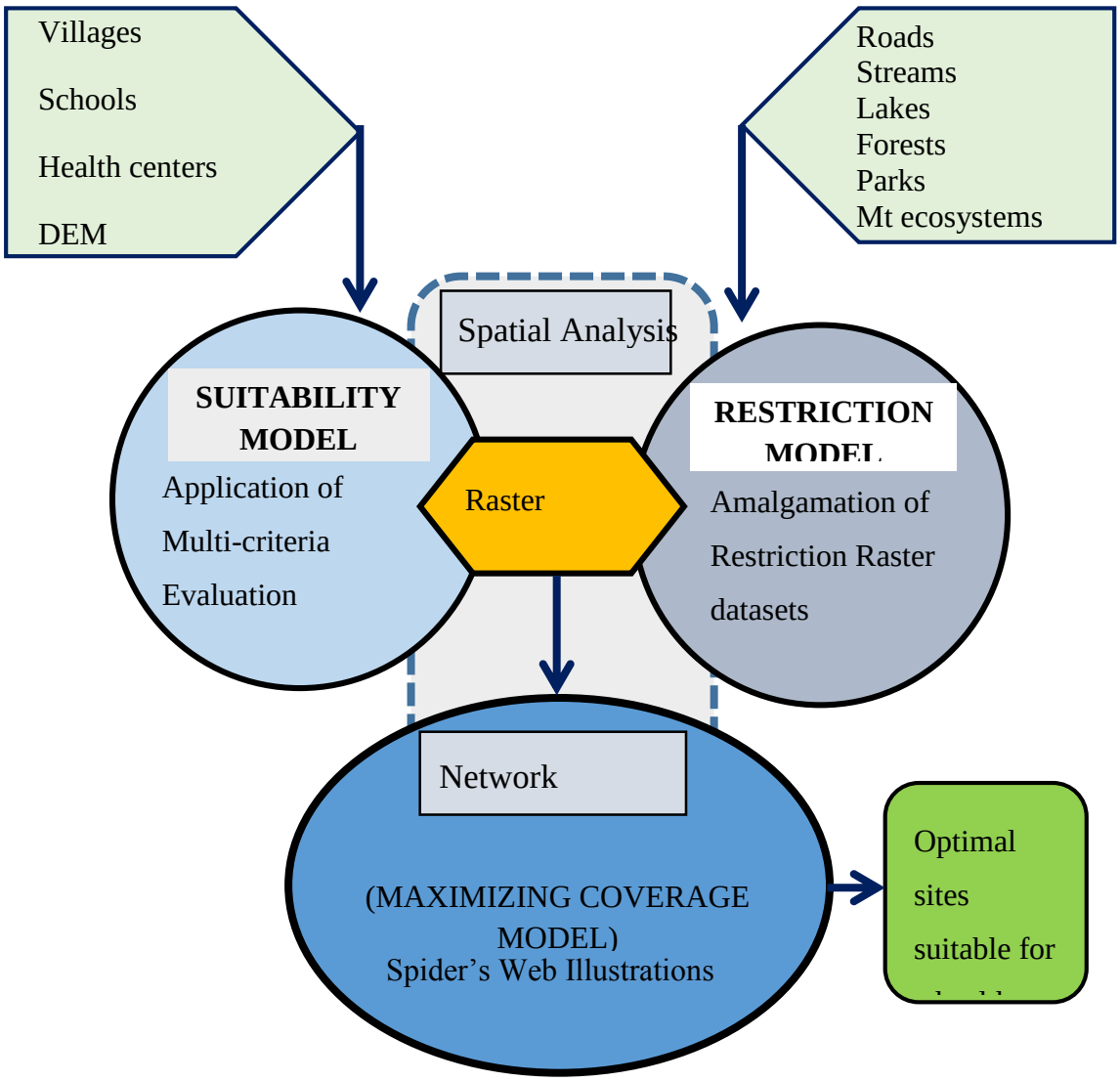


Figure 2: **Methodology workflow**

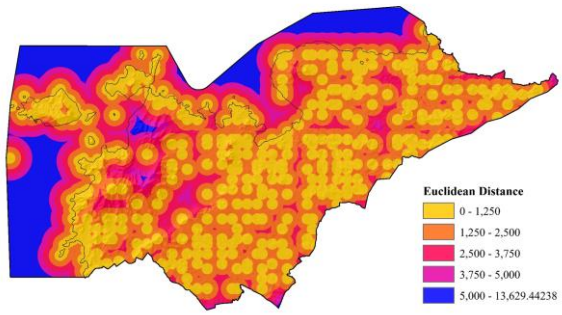
The final output is a suitability raster layer classified commensurate to the measurement scale. For instance, with a measurement scale of 1 to 10, selected sites apportioned with the value of 1 are least suitable while those with the value 10 are the most suitable locations. This paper adopted the following land use suitability and weighted site selection procedures to arrive at the identified suitable locations;

i. Input Dataset-This entailed the development of an inventory of datasets that will be exploited to facilitate the analysis. It is significant that the user identifies relevant datasets and exercise rationale discretion on the accurate datasets that would influence the spatial

analysis. The input datasets were selected based on the intended purpose of conducting a suitability analysis for citing of a health facility. Suitability according to this paper was performed within the confines of simultaneously exposing the most suitable parcels for the establishment of a health center or a hospital and extraction of incompatible land parcels for subtraction from the overall suitable parcels. This, therefore, necessitated for the design of two development model-Suitability model and Restriction model. The creation of the suitability model will be an attempt to harmonize the planning principles and requirements for locating a health station. On the other, hand restriction model was a regulative platform that inclusively illuminated the need for conservation and adherence to the conventional laws and policies regarding the relevant reserves. The reserves accommodated in the restriction model include the road reserves, riparian reserves and other environmentally fragile ecosystems such as flood-prone areas, mountain ecosystems, forests and parks.

ii. Derive Dataset- A new Information was extracted from the selected input datasets in the first stage. This is made feasible by the exploitation of spatial Analyst extension tools in ArcGIS. Spatial accessibility of the Homabay populace to health services was partially simulated by computing a Euclidean distance for the input datasets to access the proximity distance from villages and schools to existing health institutions. This also become an entry point of auditing the spatial distribution of existing health facilities and their differential distances. The Digital Elevation model which was a significant parameter was also splintered to yield the rate change of the surface. Determination of the spatial dynamics and differentials in Homabay is a significant criterion as it informs on the suitable spatial surfaces that would conveniently herald proposed developments. Slope analysis was therefore automated via spatial analysis to produce the surface syntax and spatial configuration of Homabay County.

Village distance



School distance

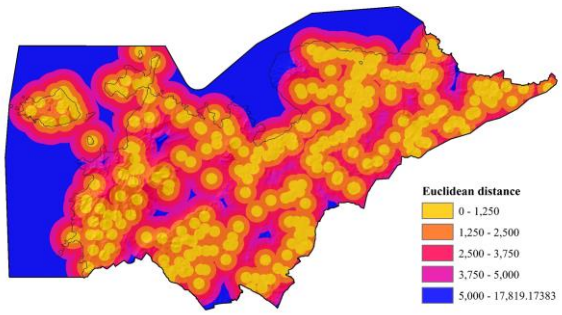
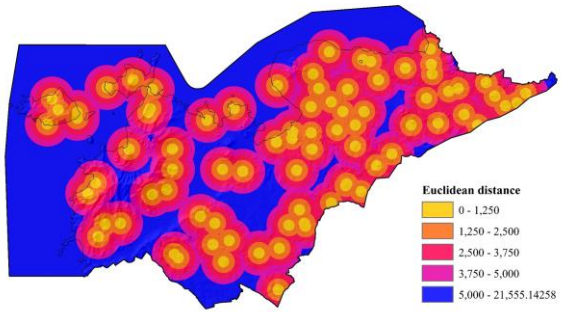


Figure 3: Suitability parameters

Health facility distance



Slope analysis

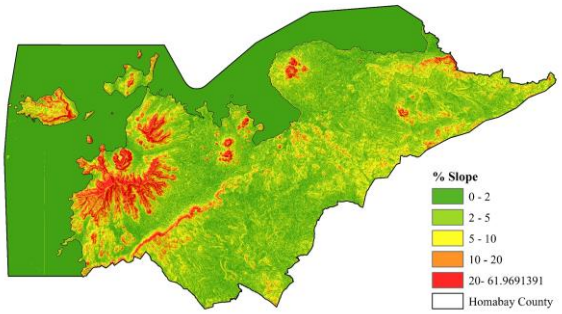


Figure 4: Suitability Parameters

iii. Reclassify Dataset-The splintered information from the second stage is exposed to a measurement scale to portray the variant degree of relative importance. The classification was achieved by a measurement scale of (1-5) with a value 1 referring to the least suitable parcels and a value 5 donating most suitable parcels for health facility citing. A considerable proximity distance of six kilometers was adopted as a standard yardstick for auditing the accessibility suitability of a patient wanting to consume health services within Homabay region. Spatial accessibility distances greater than six kilometers were regarded as distance decays causing strain in health service patronage. The tapped new information from spatial distances of the input datasets and slope raster was informed as below;

- Villages-It is worth noting that these are pertinent demand points whose numbers influence the amount of infrastructure, social and community facilities required to facilitate their mundane functions. They also encompass the relevant communities and neighbourhoods that consolidates a measurable level of planning. Hence, since villages are the dormitories in the Homabay region, suitable areas proximity to them enjoys a higher preference.
- Schools –The existing educational institutions were considered to be convergent points of a significant segment of the village populace. Children and youths have a better part of their day in school and hence the inspired idea of granting more preference areas closer to existing schools.
- Existing health facilities-Knowledge of the existing facilities illuminates the spatial accessibility index of the relevant population within a region. The suitability model classified the health center distances such that more preference was awarded to spatial locations away from the existing health institutions. This would conveniently dilute the distance decays exhibited in certain incapacitated regions of the county.
- Slope Raster-The rate change of a surface is an imperial factor for any engineering cum construction based projects. The surface architecture curtails the process of construction by imposing exorbitant construction costs, especially in steep and rapidly undulating localities. More slope preferences were enjoyed cumulatively from 1 to 20 percent slope. Regions characterized by slope percentages above 20 percent were the least preferred.

iv. Weight & Combine Dataset-This becomes the point of entry for Multi-criteria Evaluation (MCE). Heywood et al. (1995) argued that MCE is the detailed method of amalgamating disparate datasets according to their relative ranks of importance in order to make a rational decision. The relative degree of importance was achieved by exposing each parameter to a measurement scale of (1-5) with values 1 and 5 denoting least and most suitable parcels preferable for a health center. The reclassified datasets were then passed through a raster overlay chamber where a weighted overlay function was programmed to optimize the overlay process based on the relative percentages of influence of the affiliated parameters.

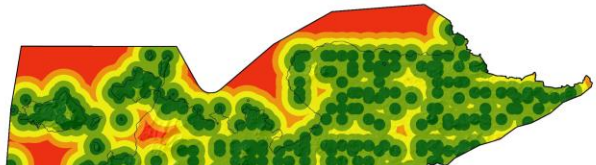
Table 2

Illustration of the incorporated weights and Multi-criteria Evaluation Algorithms

Parameter	Class	Class Weight	Description	% Influence
Village distance (m)	0-1200	5	High	40%
	1200-2500	4	Medium high	
	2500-4000	3	Medium	
	4000-6000	2	Medium low	
	6000-16460.67	1	Low	
School distance (m)	0-1200	5	High	30%
	1200-2500	4	Medium high	
	2500-4000	3	Medium	
	4000-6000	2	Medium low	
	6000-16460.67	1	Low	
Health distance (m)	0-1200	1	Low	20%
	1200-2500	2	Medium low	
	2500-4000	3	Medium	
	4000-6000	4	Medium high	
	6000-16460.67	5	High	
Slope (%)	0-5	5	High	10%
	5-10	4	Medium high	
	10-15	3	Medium	
	15-20	2	Medium low	
	20-49.462395	1	Low	

Therefore, the suitability model significantly specified the relevant criteria, standardized the criterion scores, allocated weights and applied an MCE algorithm (Heywood, Cornelius, & Carver, 2006). A weight of 0.4 was assigned to the village classified raster because the primal objective of this paper was to facilitate universal health access. Villages become neighbourhood units of measurable dimensions that is, an entry point in resource allocation. Schools registered a weight of 0.3 since they are points that enjoy regular patronage by a larger segment of the village population. Locating health centers proximity to educational institution also will undoubtedly enjoy a considerable catchment population. Defining the suitability of health centers to be away from an existing health facility was also an important criterion that was assigned a weight of 0.2. On the other hand, Slope percentages received a weight of 0.1. Inasmuch as this spatial analysis prefers regions with a relatively flat surface, it doesn't mean that regions polarized by extensive undulating slopes should not be allocated a health facility. The weighting system, therefore, sought to compute the attractiveness, preferences, desirability and bias of one parameter compared to another.

Reclassified Village distance



Reclassified School distance

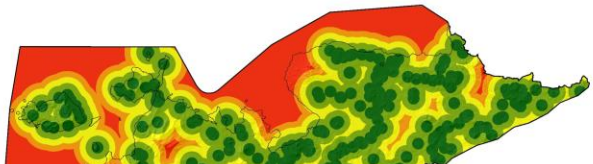


Figure 5: ***Parameters' desirability***

Restriction Model

The model was constructed by buffering relevant datasets such as roads, streams, forests, parks, mountain ecosystems, lakes and flood-prone areas. Buffering distances denote the preferable or desirable reserves prescribed to ensure convenient access and adequate cushioning of environmentally sensitive areas from human activities. The participating vector datasets were stepped up to Boolean rasters to facilitate their linear summation to a composite model of prescribed restrictions.

Table 3

Parameters' buffer distances

Parameter	Class typology	Buffer distances (m)

Road	Class A	60
	Class B	36
	Class C and others	30
Lake	Major	300
	Minor	100
	Flood-prone areas	100
Streams	Major	60
	Minor	30
Green spaces	Forest	100
	Park	300
	Mountain ecosystems	100

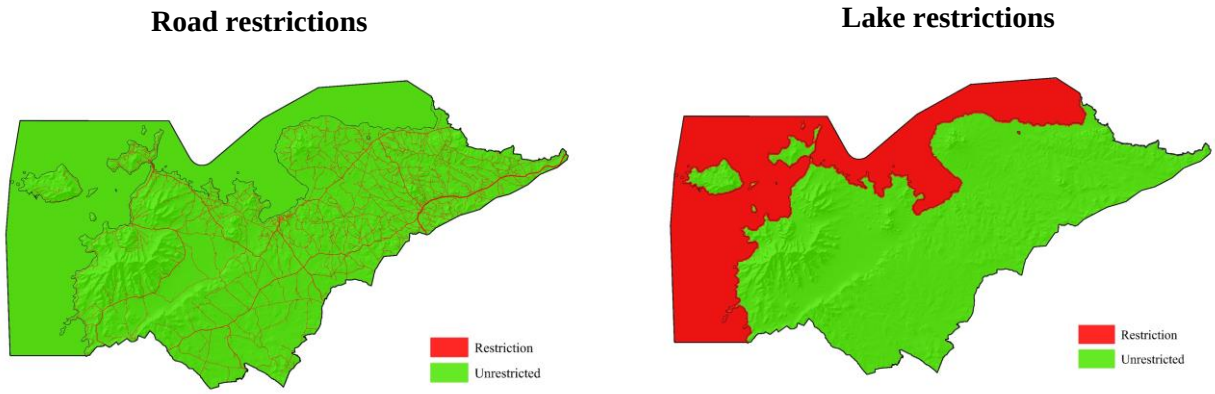


Figure 6: Restriction parameters

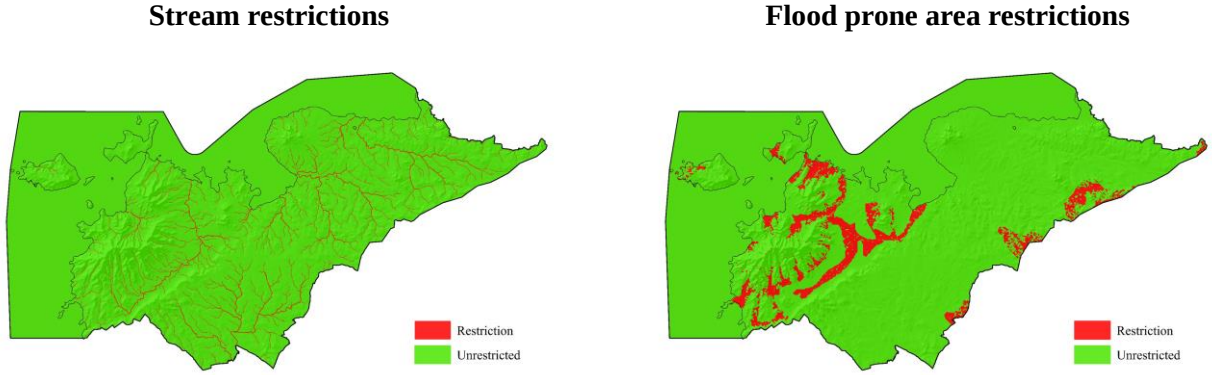


Figure 7: ***Restriction parameters***

Most suitable Model

This was a hybrid model of an amalgamation of the products of the suitability and restriction model. A raster overlay analysis was therefore performed to subtract the prescribed restrictions from the identified suitable land parcels.

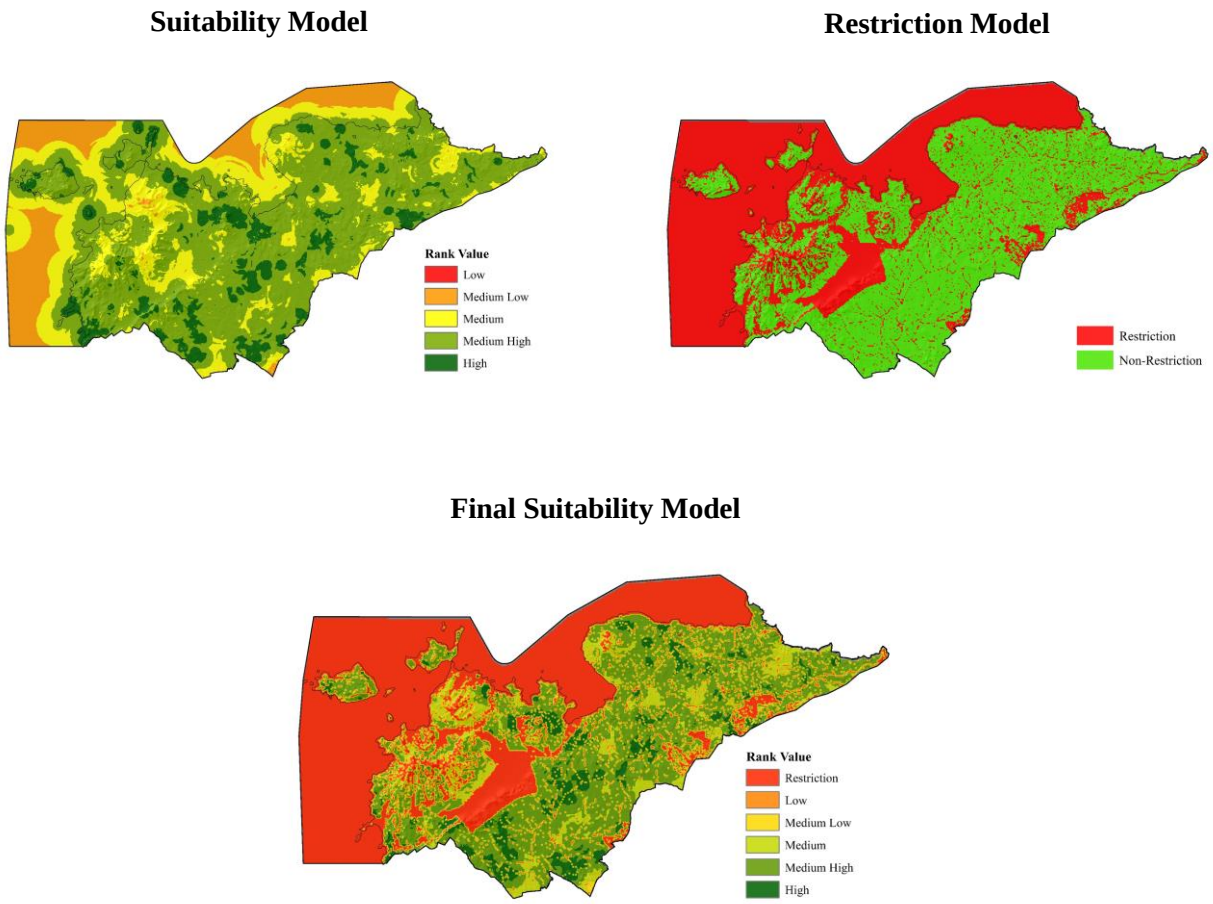


Figure 8: ***Suitability Models***

3.2.4 Maximizing coverage problem model

A road network dataset was prepared to facilitate the operation of the location-allocation models. *Maximizing coverage problem* model enabled the modeling of the existing spatial accessibility to health services. The relevant datasets at this stage were the health centers, road network datasets and the respective population centroids for the sub-locations.

4. Results and Discussions

4.1 Spatial analysis

Spatial analysis was conducted to expose suitable locations within the county to be considered for a health facility and assessing the suitability of the current health centers. This was made feasible by performing a suitability analysis that was accomplished in three phases namely design of a suitability model, programming of a restriction model and hybrid model. The hybrid model was then used to test the suitability of current health facilities. Additionally, their spatial configuration and accessibility were

also assessed by selecting those within an interval radius of fewer than 4 kilometers. The suitability revealed that *2* health centers were located within the restriction model while *12* health centers registered overlap of service areas.

***Figure 9*: Suitability analysis of current health facilities**

According to the physical planning handbook (2007), adequate land requirement to sustain functions of a health center culminates to approximately 3Ha. Only 535 suitable parcels satisfied the prescribed land provision and were assumed as the most suitable for consideration. The most suitable parcels were then converted into point features to facilitate their packaging as significant candidates in the subsequent network analysis.

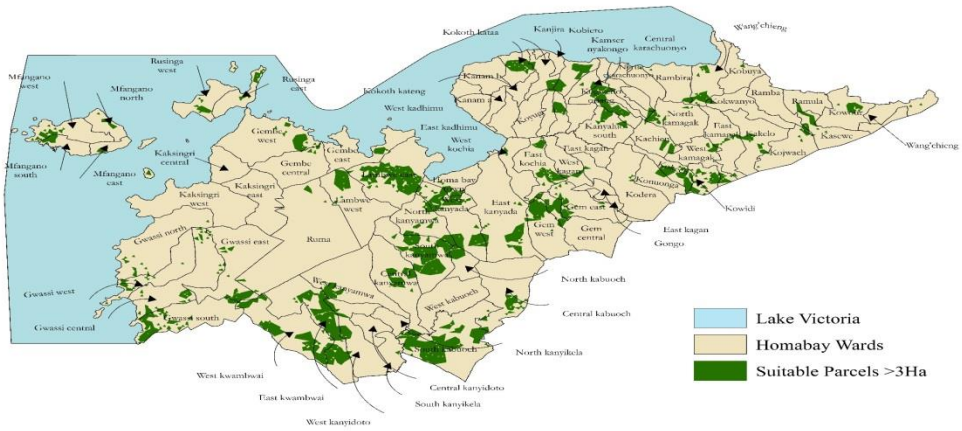


Figure 10: Most suitable parcels to be considered for establishment of health facilities

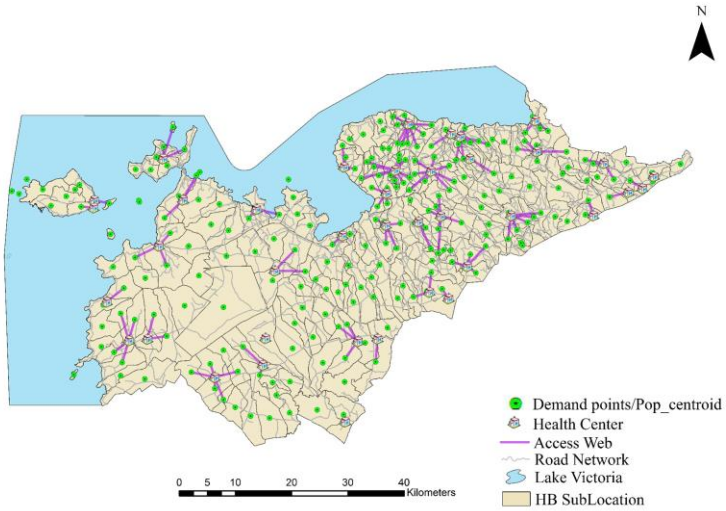
4.2 Network analysis

Location-Allocation models that functions from a Network Analyst extension in ArcGIS were used. Location-allocation models objectively choose optimal locations of facilities from an inventory of candidate locations while simultaneously assigning demands for services based on the demand distribution (Algharib, 2011). The primal objective of location Allocation is to establish the optimal facilities that best satisfies the demand points. This paper exploited the *maximize coverage model* to illuminate the accessibility landscape of Homabay residents to health center services.

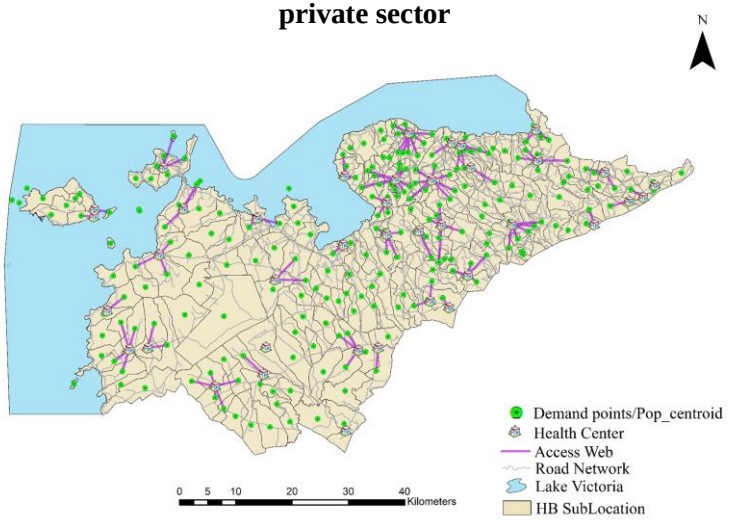
4.2.1 Bicycle/Motorbike access Model

A majority of the population (62%) use motorcycle and bicycles to access health centers (Otieno & David, 2014). The outpatient service provision in Homabay County is facilitated by the County government (26 facilities) and private sector (13 facilities). The prescribed impedance time (the maximum time a patient should incur to access a health facility) by the World Health Organization (WHO) is 18 minutes. An average speed of 20km/hr. was assumed for traversing from a patient's home to a health center using a motorcycle. Using the sub-location centroids as the demand points, the county government health centers alone registers a 43% population coverage (441,131 persons).The county government in partnership with the private sector/faith-based organizations registers a 58% population coverage (606,613 persons).

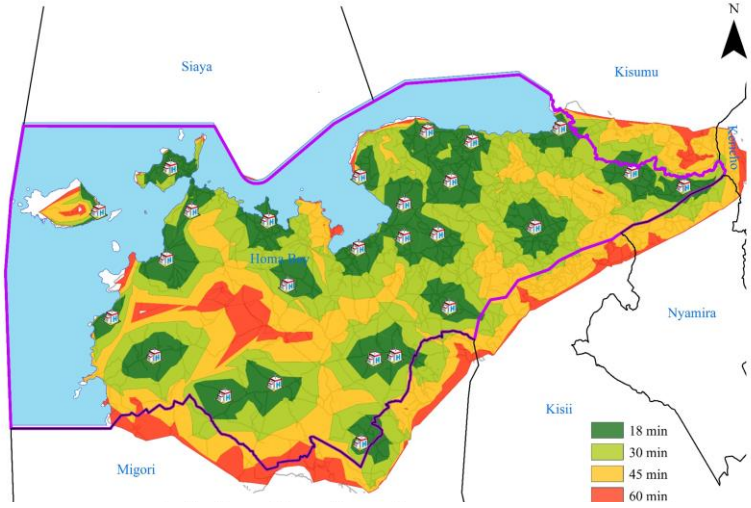
Health Coverage by the County Government



Health Coverage by both the County Government and private sector



Health service area analysis of the County Government



Health service area analysis of both the County Government and private sector

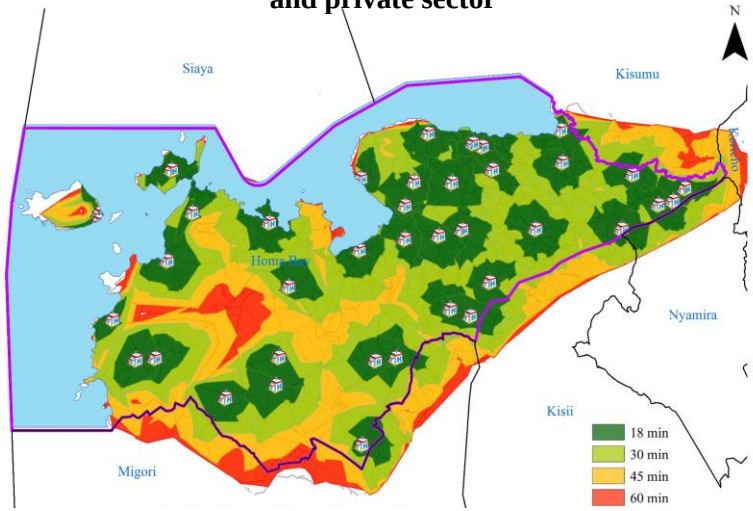


Figure 4: Spatial Accessibility Models

4.2.2 Access distance versus access time

The physical planning handbook (2007) prescribes a service radius of 5km for a health center. However, due to the differentials in the road network patients within a 5km radius of health facility may still incur more than 5km. For instance, figure 12 illustrates the accessibility dynamics within a 5km radius capture in Karachuonyo sub-county. From a birds view a patient within 5km radius from the nearest health center is assumed to be enjoying convenient access and yet, in reality he/she incurs 9km, 11km and 17km to Atemo Health Center, Mawego Mission Health center and Kabondo Health center respectively. The Culmination of the spatial accessibility can be achieved by revamping the existing nexus of the transport system.

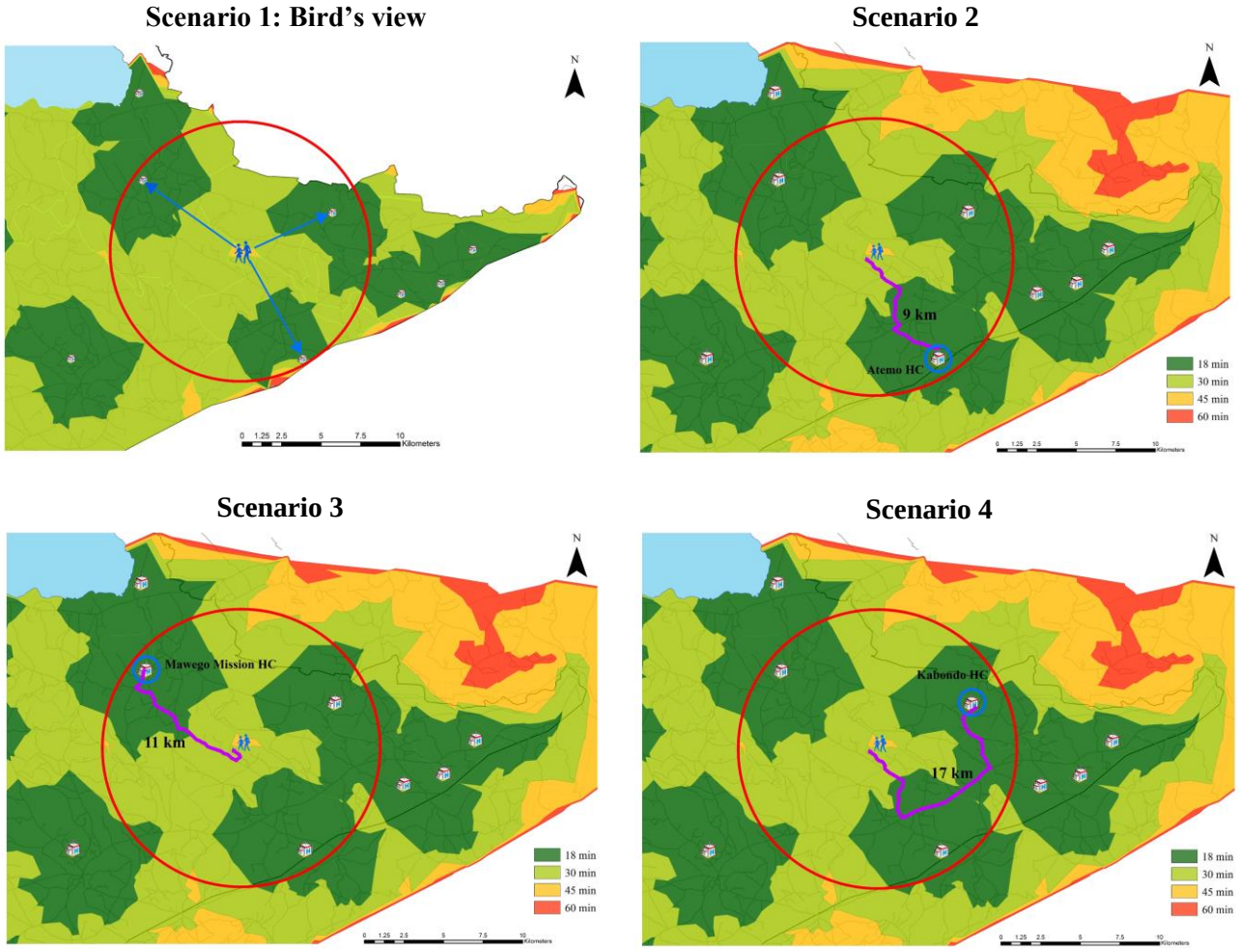


Figure 5: Locational Accessibility dynamics

4.2.3 Solution Model

The physical planning handbook (2007) apportions a catchment population of 15,000 persons to a health center. Homabay County currently accommodates a projected population size of 1,085,014 persons which commands respective 72 health centers to sustain their medical needs. However, the County is

currently sustained by approximately 39 health centers. Maximizing coverage problem model was therefore configured to pick 33 most suitable parcels from the 535 suitable parcels yielded from the spatial analysis. The model materialized a health coverage of 98% from the existing 58%.

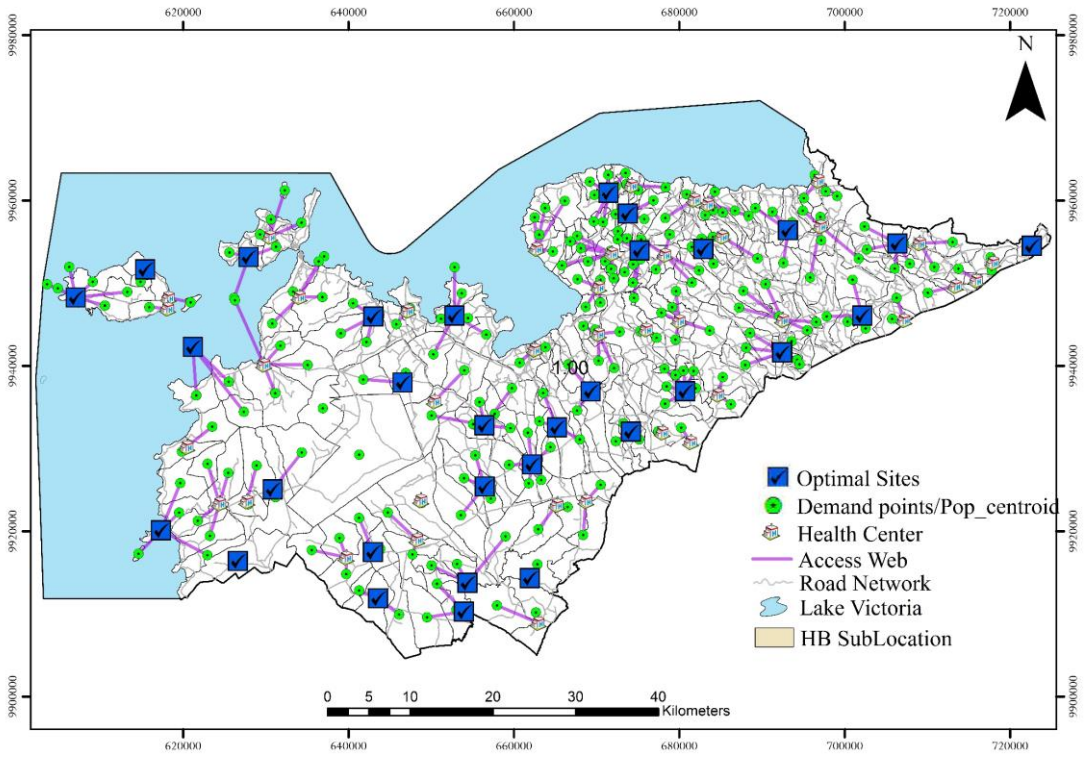


Figure 6: Optimal location of health facilities that would maximize equitable service provision

5. Conclusion

Spatial analysis per se is not enough to justify and credit location-based analysis. It must, therefore, be buttressed by exposure to network analysis. This is primarily significant in establishing synergetic networks among locations affiliated in a spatial analysis. In contemporary times, Geographic Information Systems have revolutionized the decision-making industry. Spatial analysis cemented by MCE technique has steered the highway to rational decision making. The study revealed that the current spatial health coverage in Homabay County is 58%. This has not only been caused by the incommensurate number of existing health facilities but also an overlap of service area attributed to poor infrastructural planning. The study also demonstrates that road network configurations are a significant determinant of whether a patient registers a strained or convenient access to a health facility.

The demand points used for the maximizing coverage model were the sub-location centroids. Availability of an updated village population can provide a more accurate health coverage percentage. The spatial and network analysis needs to be updated upon the establishment of health facilities. The future scope of this study is to assess the capacitated coverage of existing health facilities. This will demonstrate the worst-case performance of health facilities justified by indicators such as response time, availability of personnel e.g. doctors, nurses, etc, availability of infrastructure e.g. maternity wards, drugs, ambulance services. This will provides an entry point to ascertain the proper mix of health services and optimal facility hierarchy that ensures equitable service provision.

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A Critical Analysis to the Process of Supervision: Exploration of Supervisee challenges

Dr Hellen K. Guantai & Dr Solomon G. Mwaniki

Abstract

The gist of this study was to analyze the supervision challenges that postgraduate students undergo in the course of doing their thesis or project work in universities. The purpose of this paper was to explore the challenges that make the process of postgraduate supervision a hindrance that affects the students' enthusiasm to learn and successfully complete their studies on schedule. The objectives of the study were to: ascertain the perceptions of post graduate supervisee towards supervisory competences of their supervisors, assess the channels of communications between supervisee and supervisors, and establish the availability of supervisors to the supervisee. The paper used a cross section survey design to capture the views of respondents. The study used a sample size (n= 95) which was derived from a target population (N = 198) consisting of; all masters and doctoral students in the School of Education and School of Business & Economics of Kenyatta University and Mount Kenya University respectively. The study used questionnaires to collect data. The main findings of the study were: supervisors were found to have established friendly interactions with supervisee, but did not embrace ICT in supervision, supervisors did not give prompt feedback to their supervisee; and supervisors were hardly accessible to supervisee. The study concludes that the process of supervision had many challenges like feedback to students was not effective and many of the supervisors were not able to embrace ICT. This study recommends frequent re-tooling for the supervisors so that they are able to embrace online supervision and hence assist the students to expedite the process and complete on time. This study is significant as it may inform both the supervisors and supervisee on the best practices of undertaking the process of supervision for both parties to work harmoniously.

Keywords: Supervisor, Supervisee, Supervision Challenges, Supervisory Competences

Introduction

In pursuance of postgraduate academic qualifications, supervision of postgraduate students has been a critical issue of focus among scholars for a long time in the universities. According to Core, R. S. (2017) the relationship between supervisor and supervisee is the foundation of the work that will be seen as the outcome of the whole process. Numerous studies have documented that the challenges that post graduate students undergo can be summarized in terms of translating to poor quality of supervision and completion rates (Cranfield& Taylor 2008; Lessing & Lessing 2004; Lessing & Schulze 2002; Van der Westhuizen & De Wet 2003). This is because the process of achieving a PhD is lengthy and complicated; it demands competence, commitment, time, energy and emotion from both the supervisor and postgraduate student (Li & Seale, 2007).

Scholars have also established that having a doctorial degree not necessary mean that one has all the competences for supervising postgraduate students (Bitzer, 2007; Du Pré, 2009, Mainhard, Van der Rijst, Van Tartwijk & Wubbels, 2009; Olivier, 2007). The implication here is that despite supervisors having the qualifications needed to supervise the students there are other hidden factors that derail the process. This is reflected in the slow completion rates the student's respective degrees. Specifically, Academy of Science of South Africa (ASSAf, 2015) observes that there are factors that determine the success of research students in doing their postgraduate programs. Critical among these are the supervisors and effective supervision. The study established three most important attributes of supervisors as: supervisors should be friendly, approachable and flexible; knowledgeable and resourceful; and encourage students to work and plan independently. However the extent to which the supervisors had the ability to utilize these attributes to support the postgraduate students was the focus of this study in terms of unearthing the challenges that postgraduate students encounter in the process of supervision. The pertinent question in this study was, what were the challenges that supervisees encountered in the process of supervision which affected their timely completion.

Purpose and Objectives of the Study

The purpose of conducting this study was to analyze the process of supervision by exploring the challenges that supervisee encountered in the course of their postgraduate supervision for projects and thesis. This study was guided by the following objectives;

a) Establish the perceptions of supervisees on the supervisors' supervisory competences

b) Determine the channels of communication between supervisee and supervisors
c) Determine the availability of supervisors to the supervisee

Problem Statement

There is evidence from research to demonstrate that the process of supervision among postgraduate students is problematic in most of the universities globally. This is despite the critical role that the process plays towards completion of the students programs. The ideal situation is that effective supervision process should lead to faster completion, but the reality is that students have taken long periods to complete their studies despite the interventions put in place by many universities. There is evidence of undesirable experiences narrated by students about the whole process of supervision that culminated to delayed completion of their respective degrees. Consequently this study was conceptualized to look critically at the process of supervision with a view of unearthing the challenges that students encounter.

Literature Review

Perceptions of supervisee on the supervisor's supervisory competencies

In an extensive study on supervisor's supervisory competencies, Rahabav, P. (2016) found that academic qualifications of university supervisors need to be always supported with special education and training that are particularly relevant to academic supervision. Based on the supervisors' supervisory competencies, it is always anticipated that supervisees' will perceive their supervisors competence and ability to supervise highly so that they are able to create a good working relationship. Ezebilo, E. E. (2012) observes that for supervisee to form positive perception of their supervisors, the supervisors must provide adequate guidance and mentorship to their supervisees. This is essentially because the way a supervisee views a supervisor comes from the ability of the supervisor to deliver on the process of supervision. This has not been good because according to Lizzio, Stokes and Wilson (2005); relative to the process of supervision, the supervisees roles have received little attention and this has affected their morale in the process. The supervisees needs to be fully involved in the process and need not be bystanders so that they can work together. In the ideas of Bernard and Goodyear (2013), the supervision process is evaluative and has three functions which are expected to be concurrent. These include; (1)enhancing the professional growth of the supervisee, (2) monitoring the quality of professional

services offered to the clients that she or he sees, and (3) serving as a gatekeeper for those trainees who are to enter the particular profession. These functions have the potential to drive the process smoothly but the irony is that the process is complicated and supervisors lack the competencies needed to expedite the process.

(ii) Communication channels between supervisors and supervisees

To successfully complete of postgraduate, a growing number of studies highlight communication as being pivotal factor in determining the relationship between postgraduate candidates and their supervisors (Emilsson & Johnson, 2007; Gill & Bernard, 2008; Green, 2005). This is because effective communication creates a strong bond between the supervisor and supervisee and this is critical to expedite the supervision process. Hein and Lawson (2009) found that supervisee incompatibility arising from poor communication could compromise supervisor feedback by sometimes making it difficult for the supervisor to provide positive or negative feedback to a supervisee. In this regard, the supervisor has a critical position in the process of supervision and hence should be able to initiate the process of effective communication with the supervisee and this will make the process a smooth flow. In the words of Mitchel (2019), as a PhD supervisor, you have the power to make or break your students' career hopes. Your influence is immense, and your role crucial; they are responsible for providing supervisees with constructive feedback about their progress and this keep the post graduate students motivated and on track. Communication skills are important because the way supervisors interact with supervises affects how well they receive supervisor feedback. A supervisor with the capability to communicate instructions and corrections to students clearly, succinctly and in a manner that motivates students instead of alienating them is a more effective in the whole process. Indeed effective communication is the art of driving the whole process.

(iii) Availability of Supervisors to the Supervisee

A study on effective PhD supervision by Abiddin, Hassan, A. & Ahmad, (2009), outlines some of the problems involved in the process of supervision as lack of understanding by the students yet supervision is a student driven process. The presence of the challenges in the process will mean that students will take longer than usual to complete. They also point out failure to communicate by the institution as to the standard of work required for a particular degree as a critical factor that

affects process since many students work without having a clear timeframe of what is expected. This means that students work blindly and waste valuable time that would have been used in their work and this lengthens the period taken by postgraduate students to complete.

According to a study by Ezebilo, E. E. (2012) the success of research by post-graduate students largely depends on their relationship with supervisors. However, Ndayambaje (2017) observes that supervisors are far from being available to the supervisee so as to create the much needed academic and research oriented relationship. This imply that supervisee don't have sufficient time to interact with supervisors in the course of supervision and build working relationships that can lead to enhanced outcomes in terms of supervisee work. An effective supervisor is expected to initiate the process of supervision and sustain it, but the reality is that most students give up after making several attempts to book appointments with supervisors. Lichtenberg (2007) affirmed that for optimal learning to occur, solid working relationship between the supervisor and supervisee must be apparent throughout the duration a postgraduate student is doing his thesis or project.

Farizal et al. (2011) affirms that the research process involves personal and professional relationship between students and supervisors. The prevalence of challenges in the process of motivation is likely to derail the process and consequently demotivate the students. Successful research can be achieved if sustainable supervisor-student relationship is attained along the research journey, but the issue is whether the process of supervision is smooth. Supervisors have a significant role to challenge and extend their students' abilities in all areas to ensure their success, but students sometimes disappear and this makes the supervisor to appear not effective and bears the blame. Group supervision is probably the most reliable model practiced by several institutions to conduct research students due to increasing numbers of students as well as demands from academic environment held by supervisor including administration commitments. Most practitioners agree that a positive and productive relationship between supervisor and supervisee is essential if supervision is to be effective (Bernard & Goodyear, 2009; Corey et al., 2014 Henderson, Cawyer, & Watkins, 1999; Kaiser, 1997; Yontef, 1997).

Methodology

This study used cross-sectional survey design which allowed the researchers to collect data in the two institutions which was then collated to get the congruence. The target population was all masters and PhD students in the school of Education of both Kenyatta University and Mount Kenya University. The sample size (n=95) comprised of master's and doctoral students who have already finished their course work and embarked on their thesis/projects in the department of Education Management Policy and Curriculum Studies at Kenyatta University and Mount Kenya University in the School of Education and Business and economics respectively. The study used questionnaires to collect relevant data from respondents. Validity of the instruments was gotten through expert judgment from education managers to ensure that they solicited the anticipated information. Cronbach alpha was then used to establish the consistency of the research items. Data was analyzed using descriptive statistics of frequencies, mean and percentages and presented using tables and relevant figures.

Results

(i) Supervisors' Supervisory Competences

This study sought to find out the perceptions that the supervisee had on their supervisors' supervision competences in the domains of; human, technical and conceptual skills. Hence, the supervisees were required to rank some supervisory skills with 1-Strongly Agree; 2-Agree; 3-Neutral; 4-Disagree; 5- Strongly Disagree. The results are as shown in Table 1.

Table 1

Supervisee Responses on Supervisors' Supervisory Competences

Skill	Statement	N	1	2	3	4	5
Human Relations Skills	Establish friendly interactions with supervisee.	83	23	21	10	20	9
	Motivate supervisee towards finishing their work.	94	24	16	24	15	15
	Empathize with supervisee	72	10	9	16	22	15
	Informs the students once through with their document	85	20	24	21	14	6
	Understands the student context	75	18	20	15	14	8
Technical	Have specialized technical skills to assist supervisee	84	27	27	13	11	6

Skills	Give objective technical feedback to their supervisee	85	25	30	13	13	4
	Supervisors are competent in the area of supervision	84	29	25	12	15	3
	Supervisors embrace ICT in supervision	83	10	9	15	28	21
	Supervisors are objective when giving feedback	85	13	26	20	16	10
Conceptual Skills	Their verbal feedback is simplified and clear manner	85	24	36	11	11	3
	Their written feedback is clearly understood	82	22	30	10	11	9
	Supervisors demonstrate conceptual clarity of the areas the student is being supervised	85	20	30	16	12	7

Table 1 shows masters and doctoral students' views on the supervisors' supervision competences. It is explicit that majority, {23(27%) strongly agreed and 21(25%) agreed} that supervisors established friendly interactions with the supervisees. It is also apparent that most, 22(30%) students disagreed that supervisors are able to empathize with supervisee. These imply that as much as the interpersonal relations between the supervisors and supervisee are good during the supervision process, the supervisors are not able to put themselves in the shoes of the supervisees and consequently empathize with them yet as core 2010 puts it, the foundation of a good supervision is the positive rapport between the supervisor and supervisee. This is also corroborated by Ezebilo, E. E. (2012) who posits that the success of research by post-graduate students largely depends on their relationship with supervisors.

Table 1 also shows that majority, {30(35%) agreed & 25(29%) strongly agree} of the supervisees were of the opinion that supervisors gave objective technical advice to the supervisors. However, from Table 1, it is shown that majority, {28(%) disagreed & 21(%) strongly disagreed} of supervisee were of the view that supervisors embraced ICT in supervision. This implies that as much as supervisee regarded their supervisors to have technical skills needed for supervision, this was not extended via the utilization of ICT in supervision and this further contributed to delays in the process. This sentiment concurs with, Ndayambaje (2017) who observes that supervisors are far from being available to the supervisee so as to create the much needed academic and research oriented relationship and would result from lack of specific skills that they need to supervise.

Further, Table 1 shows that most {36(42%) & 24(28%)} of the supervisees agree and strongly agree respectively that feedback given by the supervisors is simplified and clear; most {22(27%) & 30(37%)} of the supervisee agree and strongly agree that written feedback given to them by their supervisors is clearly understood. Lastly, Table 1 indicates that most {20(24%) & 30(35%)} of the supervisee were of the opinion that their Supervisors had demonstrated conceptual clarity in the areas they were supervising them on. This perspective then creates irony since if students get clear feedback ,they are expected to complete on time yet this not the case as notes Lichtenberg (2007) who affirms that for optimal learning to occur, solid working relationship between the supervisor and supervisee must be apparent throughout the duration a postgraduate student is doing his thesis or project.

(ii) Communication between Supervisee and Supervisors

One of the challenges that hinder supervisee from timely completion of their research work is poor communications between supervisee and supervisors. Thus, the master's and doctoral students were required to rank the status of the various aspects of communication between themselves and supervisors in course of supervision. The ranking was coded as: 1-strongly agree; 2-agree; 3-neutral; 4-disagree; and 5- strongly disagree. This is shown in Table 2.

Table 2

Status of Communication between Supervisors and Supervisee

SN	Statement	N	1	2	3	4	5
1	The supervisors use clear channels of communication.	87	15	26	22	13	11
2	Channels of communication used by supervisors are student friendly	78	9	21	23	14	11
3	Supervisee can always communicate with supervisors without a prior appointment	84	19	20	12	17	16
4	There is no delay in obtaining feedback from supervisors	81	11	12	11	20	27
5	There is always agreement between supervisors' verbal and written communication	88	9	25	11	30	13
6	There is consistency on the feedback given by the supervisors	82	10	19	11	28	14
7	Supervisors always give prompt feedback to supervisee	85	9	15	16	21	24

8	Supervisors are cordial in all channels of communication	81	9	12	24	22	14
9	Supervisors are able to supervise online by tracking their comments	87	11	13	17	21	25

Table 2 shows that most of the respondents, {27(33%) & 20(24%)} strongly disagreed and disagreed respectively that supervisors gave prompt feedback to their students. Further, most of the respondents, 30(38%) disagreed with the opinion that there was agreement between verbal and written feedback given by the supervisors. It is also apparent that most of the respondents 25(29%) strongly disagreed that supervisors are able to supervise online by tracking their comments. These imply that most supervisors are not able to give prompt feedback to their students and that the use of ICT in tracking students' supervision is hardly used. This could be contributing to delayed completion of students research work. These findings agree with Hein and Lawson (2009) who found that supervisee incompatibility arising from poor communication could compromise supervisor feedback by sometimes making it difficult for the supervisor to provide positive (or negative) feedback to a supervisee. The implication in this context would be delayed completion.

(iii) Availability of Supervisors to the Supervisee

Finally, this study sought to establish from respondents the status of accessibility of supervisors to the supervisee in course of supervision period. To achieve this, the master's and doctoral students were asked to rank the various aspects of availability given with 1-strongly agree; 2-agree; 3-neutral; 4-disagree; and 5- strongly disagree**.** The results are presented in Table 3.

Table 3: Supervisors' Availability to Supervisee

SN	Statement	N	1	2	3	4	5
1	Supervisors are always accessible to supervisee	89	10	13	24	24	18
2	Supervisee can only meet supervisors on appointment.	85	14	19	16	24	12
3	Supervisors give supervisee quality time.	87	11	27	17	20	12
4	Time spent with supervisors adds value to supervisee's work	80	29	17	10	13	11

5	Duration that supervisors stay with supervisee work is rational	83	10	20	22	18	13
6	Supervisors are just a phone call away from the student	87	11	10	15	24	27
7	Supervisors have specific office hours when they meet the students	83	10	15	12	22	24

Table 3 indicates that most {24(30%) & 18(23%)} of the respondents disagreed and strongly disagreed respectively with the opinion that supervisors are always accessible to supervisee for consultation. It is also shown that majority {29(36%) & 17(21%)} of the respondents strongly agreed and agreed respectively with the view that time spent with supervisors adds value to supervisee's research work. Most {27(31%) & 24(28%) of the respondents strongly disagreed and disagreed respectively with the opinion that supervisors are a phone call away from supervisee for consultation. The essence of availability of supervisors is a critical hindrance because then there process must be mutual and frequent interaction would assist to point out some of the issues that derail the process. However Irene 2017 notes that supervisors are far from being available to the supervisee so as to create the much needed academic and research oriented relationship.

Discussion

The study established that despite the fact that supervisors were friendly to the supervisees, it is evident that they were not able to establish a positive rapport with them and were hence unable to empathize with them. This is line with Ezebilo, E. E. (2012) who opines that the success of research by post-graduate students largely depends on their relationship with supervisors. This contributed significantly to delaying the process of supervision. Supervisors exhibited technical skills and competencies, but it was notable that most of them were not able to embrace technology and this made the process long since most insisted on face to face supervision yet students were off campus. The study also established that supervisors were not giving timely feedback to the students and the implication is that students take long periods to complete. It was evident that most of the supervisors were not available yet supervision is a mutual process that needs two parties to be present. The study also established that supervisors were not a call away from supervisor and this sometimes makes it difficult for the student to know whether a supervisor had completed reviewing the students' work .Finally on the aspect of communication ,it was difficult for timely feedback to

be sought yet Hein and Lawson (2009) found that supervisee incompatibility arising from poor communication could compromise supervisor feedback by sometimes making it difficult for the supervisor to provide positive (or negative) feedback to a supervisee. Communication is a powerful tool that that can be used to expedite the process as observes Mitchel (2019), who observes that as a PhD supervisor, you have the power to make or break your students' career hopes. Your influence is immense, and your role crucial; they are responsible for providing supervisees with constructive feedback about their progress and this keep the post graduate students motivated on track.

Conclusions and Recommendations

In regard to the supervisors' supervision competences, the study concludes that supervisors are friendly to supervisees. However, they are unable to empathize with them. In terms of supervisors' technical competence, it was found that supervisors give objective technical advice to their students, but they have not embraced ICT in conducting supervision. In regard to communication between the supervisors and supervisee, it was established that supervisors don't give prompt feedback to supervisee and there was some dissonance between written and verbal feedback given to supervisee. Lastly, in respect to availability of supervisors to the supervisee, this study established that, supervisors are hardly accessible to the supervisee despite the study establishing that physical time spent with supervisors was found to add value to supervisee work.

Based on the study findings and conclusions, this study makes the following recommendations:

a) Supervisors in the two schools need to be constantly re-tooled so as to embrace ICT in supervision since this has the potential to expedite the process.
b) Supervisors need to be prompt in giving feedback to supervisee because they will ensure that students are kept on track and are not using delayed feedback as the reason for the delay
c) University could enforce the tracking system whenever supervision occurs to expedite the process since this will keep both parties accountable
d) Supervisors need to increase their accessibility to supervisee because supervision is an interactive process that is mutual.

Recommendations for Further Studies

This study proposes that further studies can be done in the following areas;

a) Establish the challenges that supervision encounter in course of supervising post-graduate studies.

b) Determine the role of university administration in intervening to resolve the challenges encountered by supervisors and supervisee of post-graduate studies.

c) To establish the effectiveness of the tracking forms in supporting student completion of their respective programs

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Values-based Leadership: A Model for Higher Education Management

Dr. Daniel Otieno

Abstract

Values-based leadership approaches are gaining greater emphasis in Higher Educational management. The process through which educational leaders develop and integrate values in their

management practices is a matter of concern considering the Chapter 6 of the Constitution of Kenya has entrenched issues of integrity and leadership. This study examined how leaders develop their values systems and the practice of values-based leadership in management of higher education in Kenya. The study addressed the following research objectives: to establish how leaders develop values systems; to determine how leaders practice values-based leadership in Kenyan universities. A mixed research design was used with quantitative and qualitative data collected concurrently and triangulated for validation. Target population comprised 12 chairs of departments and 360 faculty members in private faith-based universities. The sample size comprised of 12 purposively selected chairs of departments and 140 faculty selected through simple random sampling. Data was collected using questionnaires and interviews. Questionnaires were administered to the faculty members while chairs of departments were interviewed. Descriptive statistics were used to present findings. Mean evaluation rating and standard deviations were used to report on the determinants of values-based leadership and the extent to which chairs of departments practice values-based leadership. The major findings of the study were that the development of values systems in Chairs of education departments in private Christian universities is determined by several variables including family upbringing, spirituality, socialization and spirituality. These leaders practice values-based leadership across several dimensions including modelling positive behaviour, vision casting, and inspiration among others. The study proposes a model of values-based leadership in education. This model explains how values can be developed in leaders to achieve congruency with organisational values and effectiveness.

Keywords: Model, Values-Based Leadership, Strategic Management, Higher Education.

Introduction

Values-based leadership has been adequately addressed in business-related scholarly literature. It has been widely applied to leadership and management of business organisations. Within educational circles, some studies have been done particularly at primary and secondary school levels (Allio, 2015; Burch, Swalis, & Mills, 2015; Simsek, 2013). However, in higher education,

few studies deal with the practice of values-based leadership and its relationship with strategic management (Ombiro, 2016; Simsek, 2013; Mulili & Wong, 2011). Interest in values has gradually gained prominence and recently, the Kenyan government mainstreamed a national values framework in the national curriculum. These values are enshrined in the Constitution of Kenya and educational institutions are expected to integrate them in their programmes. Therefore, Universities have made efforts to adopt values-based management approaches. Ongong'a and Akaranga (2013) reiterate that it is difficult for higher education institutions to ignore the role of ethics workplace. Universities in Kenya have articulated their core values in their websites and mission statements which attest to their commitment to inculcate these values into their management systems.

Among the reasons for the growing emphasis on values within Universities is the need to entrench ethics and integrity in leadership. Universities are facing challenges related to integrity and ethical professionalism (Ongong'a & Akaranga, 2013; Mulili & Wong, 2011). Acts of scientific fraud, such as fabricating or manipulating data, financial mismanagement, plagiarism and missing marks are surprisingly commonplace, but underreported. There are increasing concerns with issues of ethicality of the academy and the integrity of higher education (Gallant, 2011). These ethical issues are not limited to higher education, but cut across the entire social spectrum (Gallant, 2011). This presents a serious moral crisis for educators and leaders who are responsible for providing ethical oversight to individual actors and entrenching ethical cultures within their institutions.

Statement of the Problem

The type of leadership style adopted by institutional leaders greatly influences the performance of employees and the extent to which the strategic objectives of the organisation are achieved. Many organisations are adopting values-based approaches in their management styles as a way of achieving greater organisational effectiveness (Copeland, 2014). Despite this, they have to contend with the challenges discussed earlier on. Drew (2010, p.1) reported that the most significant challenges "centered on the need for strategic leadership, flexibility, creativity and change capability". According to O'Toole (1996) values-based leadership embodies values such as integrity, vision, trust, listening, respect for followers, clear thinking and inclusion. These values provide moral compass for making informed decisions (Warwas, 2015). This study sheds additional light on how organisational leaders develop values and apply values-based principles in their daily management practices. It aids in understanding the interrelationships between values-

based leadership and strategic management practices in private Christian Universities in Kenya. The study addressed the following research objectives: To establish how leaders develop values-based leadership, to determine how values-based leadership can be effectively practiced by educational leaders in Kenyan universities.

Methodology

A mixed research design was used with quantitative and qualitative data collected concurrently and triangulated for validation. Target population comprised 12 chairs of departments and 360 faculty members in private faith-based universities. All private Christian Universities with Faculties or Departments of Education were involved in the study because of their leading role in providing values-based education. Leaders and faculty in these Universities are expected to be exemplars of the values they espouse. The participating Universities requested for confidentiality. Purposive sampling was used to select 12 Chairs of Departments (CODs) while simple random sampling was used to select 140 faculty members. Data were collected using questionnaires and semi-structured interview guides. The questionnaire items included responses on a four-point scale which elicited responses on the practice of values-based leadership. Questionnaires were administered to faculty members while interview schedules and self-evaluation tool were used to collect data from the CODs. The questionnaires were used because they enabled the researcher to obtain information about the stakeholders' perceptions. Cronbach reliability coefficient was used to establish the validity of the instruments which was above 0.7. In the context of the findings of this study, the praxis of values-based leadership refers to the way the principles and concepts of values-based leadership are practised by the CODs. To establish the extent to which leaders practice values-based leadership mean ratings of the CODs and Faculty evaluations of values-based leadership practices were computed.

Findings and Discussion

In order to establish how leaders develop values systems, data was obtained from CODs. These responses were analysed using descriptive statistics. The summary of the descriptive statistics is presented in Table 1.

Table 1

Descriptive Statistics: How Leaders Develop Personal Value Systems

	Min	Max	Mean	Std. Deviation
My cultural upbringing has influenced my personal value system	2	4	3.42	0.79
The organisational values have an effect on my personal values systems	3	4	3.42	0.52
I have aligned my values with those of the organisation	3	4	3.50	0.52
Social interaction has affected the development of my value systems	1	4	3.08	0.99
My workplace colleagues have significantly influenced my values	1	4	2.92	0.90
My family upbringing had an influence on my personal values	3	4	3.83	0.39
My parents played a significant part in forming my values	3	4	3.67	0.49
Religious values have influenced my own values system	2	4	3.83	0.58
I acquired personal values from my mentor/predecessor	1	4	2.75	0.75
Professional training has impacted on my personal values	3	4	3.50	0.52
N = 12				

The descriptive statistics of the participants' responses are summarised under major themes as follows: religious values, family upbringing, organisational values, cultural upbringing, professional training and social interaction. The response items that are related were analysed, merged, and discussed under a common theme. These themes were derived from the review of extant literature and analysis of qualitative data.

Table 2

Descriptive Statistics: Determinants of Personal Values

	Min	Max	Mean	Std. Deviation
Religious Values	2	4	3.83	0.58

Family Upbringing	3	4	3.75	0.34
Organizational Values	3	4	3.46	0.40
Cultural Upbringing	2	4	3.42	0.79
Professional Training	2	4	3.13	0.57
Social Interaction	1	4	3.00	0.80
N = 12				

The determinants of personal value systems evolved under the following thematic areas: religious values, family upbringing, organizational values, cultural upbringing, professional training and social interaction. These are the key factors that determine how leaders develop their values systems.

In order to establish the extent to which leaders practice values-based leadership mean ratings of the CODs and Faculty evaluations of values-based leadership practices were computed. The findings are presented in the Tables 3 and 4 that follow. This revealed that the mean of the CODs self-evaluation was low in several areas. These include value alignment, mean = 3.42, knowledge sharing, mean = 3.33, mentorship, mean = 3.09 and training, mean = 3.33. This implies that CODs have not developed strong competencies in these dimensions. High means were reported in the following areas – upholding moral standards, mean = 3.92, motivating colleagues, mean = 3.83, modelling positive behaviour and integrity, mean = 3.83.

Table 3

Descriptive Statistics: COD's Self-evaluation

	Min	Max	Mean	Std. Deviation
I am driven by a set of core values	2	4	3.75	0.62
I have developed a personal values system	2	4	3.75	0.62
I have aligned my values system with that of the organisation	2	4	3.42	0.67
I have a high sense of integrity	3	4	3.83	0.39
I am honest and truthful with my followers	1	4	3.58	0.90
I uphold personal moral standards	3	4	3.92	0.29
I motivate my colleagues to high levels of performance	3	4	3.83	0.39
I model positive behaviour	3	4	3.83	0.39
My motivation style is not based on reward and punishment	3	4	3.67	0.49
I transform my followers to pursue higher ideals for their interests and the University	3	4	3.67	0.49
I am concerned with the welfare of the workers	3	4	3.75	0.45

	Min	Max	Mean	Std. Deviation
I endeavour to ensure my staff are satisfied and interested in the University	2	4	3.82	0.60
My primary motivation is what I can give to the University, not what I can get	2	4	3.67	0.65
I develop value consciousness in my followers	3	4	3.75	0.45
I inspire my followers to live those values on a daily basis	3	4	3.58	0.52
I am motivated to serve others' needs first rather than my own	3	4	3.67	0.49
I have established a tradition of knowledge sharing within the organisation	2	4	3.33	0.65
I mentor and coach employees for their professional development	2	4	3.09	0.54
New employees are trained to have a clear understanding of the organisation's standards.	2	4	3.33	0.65
I create an environment where staff engage in continual improvement	3	4	3.50	0.52
I regularly communicate the organisations values and principles to employees	3	4	3.50	0.52
COD's Self-evaluation of Values-Based Leadership Practices N = 12	**3.05**	**3.95**	**3.63**	**0.27**

The overall mean rating of CODs self-evaluation of values-based leadership practices was computed. Similarly, the overall rating of faculty evaluation of CODs values-based leadership practices was computed to give a general mean. The faculty differed moderately, SD = 0.55 in their evaluations of the CODs values-based leadership practices.

Table 4

Descriptive Statistics: Faculty Evaluation of CODs Values-based Leadership Practices

	Mean	Std. Dev.
The chair is driven by a set of core values	3.61	0.73

The chair has a well-developed values system	3.47	0.74
The chair has aligned his/her value system with that of the organisation	3.42	0.80
The chair has a high sense of integrity	3.60	0.70
The chair upholds personal moral standards	3.64	0.67
The chair motivates colleagues to high levels of performance	3.42	0.82
The chair models positive behaviour	3.50	0.81
The chair's motivation style is not based on reward and punishment	3.35	0.82
The chair transforms followers to pursue higher ideals for their interests and the University	3.40	0.83
The chair is concerned with the welfare of the workers	3.40	0.79
The chair ensures staff are satisfied and interested in the University	3.28	0.91
The chair's primary motivation is what he/she can give to the University, not what to get	3.31	0.89
The chair's develops value consciousness in the followers	3.33	0.86
The chair inspirer's followers to live their values on a daily basis	3.31	0.93
The Chair is motivated to serve others needs first rather than his/her own	3.30	0.94
The Chair has established a tradition of knowledge sharing within the organisation	3.44	0.71
The Chair mentors and coaches employees for professional development	3.37	0.84
New employees are trained to have a clear understanding of organisation's standards.	3.39	0.81
The Chair has create an environment where staff engage in continual improvement	3.34	0.86
The Chair regularly communicates organisations values and principles to employees	3.35	0.92
Faculty evaluation of COD's values-based leadership practices	**3.40**	**0.55**

N = 140 Minimum rating = 1 Maximum rating = 4

The extent to which leaders practice values-based leadership (VBL) is explained in terms of the CODs self-evaluation rating of their leadership practices and faculty rating of the CODs leadership practices. The CODs self-evaluation of VBL revealed a Mean = 3.63 and SD = .27. This confirms that CODs practice values-based leadership. This was complemented by the faculty evaluation of CODs leadership practice, where Mean = 3.40 and SD = .55. The faculty agree that the CODs practice values-based leadership. However, the means reveal slight differences in the faculty and CODs self-evaluation of VBL practice.

The findings of the study reveal that Chairs of Departments practice values-based leadership along the several dimensions i.e. having a personal values system, developing a sense of integrity and personal moral standards (Gergana & Ford, 2011). They endeavour to motivate their colleagues, model positive behaviour (Copeland, 2014). Servant leadership emerged as an important dimension where leaders aim to serve the needs of others before those of the organisation (Fehr, Yam, & Dang, 2015; McMahone, 2012; Schwepker & Schultz, 2015). Values-based leadership manifests itself inform of selfless service (Russell, 2012), value consciousness (Hall, 2016), open knowledge sharing and staff mentoring (Ferguson & Milliman, 2008). The Kaizen principle of continuous and never-ending improvement (Imai, 1996; Imai, 1997) forms a vital part of values-based leadership (Jenkins & Jenkins, 1995). Communication is a vital component in espousing values and principles, because when values are not communicated properly, the effect can be negative for both the individual and the organisation (Ferguson & Milliman, 2008).

Recommendations

This study makes several recommendations that have theoretically and practically significance. The development of personal values systems occurs across several dimensions. These include religious and family upbringing, organisational/cultural contexts, professional training and social interaction. The study recommends that University management should encourage the development of values along these dimensions. Efforts should be directed to developing an organizational climate that fosters spirituality, moral uprightness, ethical behaviour and authentic leadership. Organisational leaders must work towards developing congruency between personal and organisational values to achieve effectiveness. The model of developing values needs to tested and validated in large scale studies. There is need to conduct further research within the public Universities on the practice of values-based leadership.

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Uptake of Technology in Teaching and Learning: A Case of School of Education, Kenyatta University

Damaris Kariuki & Dr. Hellen Guantai

Abstract

Technology integration in higher education plays a critical role in fostering development in all spheres of life particularly in this digital era. Higher education in Kenya is geared towards training graduates to acquire digital skills and competencies that will enable them facilitate the teaching and learning. The purpose of this study was to assess the uptake of technology in teaching and learning at the school of education, Kenyatta University. The objectives were; to determine the faculty perceptions in the uptake of technology in teaching and learning, to assess the utilization of technology in the teaching and learning processes, to identify the challenges faculty encounter in uptake and utilization of technology. Descriptive survey design was used. The study was conducted at the school of education, Kenyatta University. The target population was all the 144 faculty members, 2000 postgraduate students undertaking master's and doctorate studies in the school of education. Simple random was used select a sample size of 215 respondents specifically 15 faculty members and 200 postgraduate students. Data was collected using questionnaires for faculty and students. The study revealed that technology integration was

perceived by both faculty and students to be effective in facilitating teaching and learning. However, the study showed that students perceived faculty motivation, integration of technology in teaching and learning and utilization of online search strategies as wanting. The uptake of technology in assessment and student supervision was also found to be low. The study concluded that faculty uptake of technology in teaching and learning was inadequate and therefore recommends continuous retooling of faculty capacity in the utilization of technology in all aspects of teaching and learning.
Key words: Technology; Teaching; Learning

Introduction

Technology use for teaching and learning is gaining momentum globally, however a formal integration of Information Communication Technology (ICT) in the Kenyan universities especially among faculty members is a mirage. This is ironical given that Kenya is currently changing her education system with a view to producing graduates who meet the skills requirements of the 21st century. This means that teachers who are expected to teach graduates must be keep abreast with technological changes and specifically how it will be utilized as they facilitate the teaching and learning processes. The Competency Based Curriculum model that Kenya is adapting is geared to producing empowered, ethical citizens who are globally competitive. Unfortunately, teachers who are implementers of this curriculum have not been able to embrace technology, which is a key skill competence they are expected to impart to the learners. As opines Kong et al (2014) teaching in the 21st century has changed and there is need for teachers to infuse technology resources in their classroom for them to be able to meet the technological requirements of the students. However, the irony is that teachers are far from embracing technology fully to take charge of their classrooms.

The Government of Kenya has made it a priority to provide every Kenyan learner with world class standards in the skills and knowledge that they require in order to thrive in the 21st century. Notably, the teacher educator who is expected to actualize the acquisition of the skills is often left behind hence the uptake of technology in the teaching and learning has been painfully slow. Teaching for the new emerging society requires ICTs to facilitate learning needs for social and economic development (MOE 2006). The question is whether the teachers are ready for the uptake of technology in the enhancement of teaching and learning. Teachers' e-learning skills are significant to the delivery of an effective teaching and learning process, hence the readiness to uptake technology becomes a critical issue of focus among universities.

Universities are expected to adopt cutting-edge technological solutions and teaching practices, but there are many barriers preventing institutions from this uptake. Key among the barriers is poor uptake by faculty members who have perceptions that hinder their effective delivery. According to NMC Horizon Report (2014), there is low digital fluency among faculty members. This has contributed to the uptake of technology remaining low and hence a quality concern. In both the

developed and developing world, this gap continues to widen, and the technology based solutions for providing greater access to knowledge, such as MOOCs, have little effectiveness if the proper infrastructure or connectivity are not readily available. Higher education stakeholders are facing a reality that is difficult to digest; the paradigm that has worked for over a century is gradually becoming obsolete, and universities must renovate - or in some cases rebuild their foundations - if they want to stay relevant. The faculty members must be receptive to new technologies. This study was inspired by a communication from the University academic division that only 30% of the faculties were interacting with students online. The overall objective of this study therefore was to establish the views of the faculty and postgraduate students on technology uptake and utilization in the teaching and learning.

The objectives of the study were:

1. To determine the faculty perceptions in the uptake of technology in teaching and learning.
2. To assess the utilization of technology in the teaching and learning processes.
3. To identify the challenges faculty encounter in uptake and utilization of technology

Problem Statement

Universities globally have embraced the uptake and utilization of technology as a convenient way for faculty to facilitate an effective teaching and learning process. Resources have been directed to supporting faculty to embrace technology in teaching, but despite all the efforts there is evidence of poor uptake and utilization of technology in fostering an effective teaching and learning process (Makura, 2014). Regrettably, most faculty members still use the traditional way of teaching with little emphasis on technology. Consequently they are not able to revolutionize their teaching and learning processes despite students belonging to the digital literacy era. The implication of this is that, learners are only consuming information without applying it. The paper therefore seeks to establish the uptake and utilization of technology among faculty members at the school of Education, Kenyatta University.

Literature Review

Faculty Perceptions of Technology Use in Teaching and Learning.

In higher education there has been a growing interest in supporting faculty in the improvement of instruction, assessment of student learning outcomes, and the integration of technology in teaching and learning. This sentiment is supported by Vajargah, Jahani and Azadmanesh (2010) who argued that ICT literacy was imperative in a higher education context. It necessary to underscore that faculty beliefs, values and perceptions of technology integration into the curriculum and instruction are factors that could associate with their technology use in instruction. Faculty attitudes encompass faculty feelings or perceptions about technology integration in curriculum, faculty motivation for adoption of instructional technology, faculty perceived barriers and challenges to adoption of instructional technology, and faculty perceived effects/benefits of instructional technology on students and pedagogy. The Commission for University Education guidelines require that universities adopt the blended mode of teaching i.e. face to face and online interaction. However, majority of the universities are still using the face to face mode of teaching which begs the question as to whether the trend is due to deficiencies among the faculty members.

Palak (2004) investigated teachers' beliefs and values towards technology integration and found that instructional technology practices of teachers in substantial ways relate to (i) their beliefs about teaching and technology and (ii) the contextual conditions in their teaching environments. He reported that teacher beliefs are the primary agents for their instructional technology decisions specifically for their selections of technologies for student use, and that the types of technologies teachers have their students use are directly related to the ways teachers approach teaching and technology.

There are three important factors that relate to technology integration across the curriculum: (i) technology-oriented curriculum (Johnson & Howell 2005), (ii) faculty attitudes, perceptions and values attached to the integration program (Palak 2005), and (iii) on-going faculty technology professional development needs (Graves & Kelly 2002; Kidney 2004). Interactivity of these three factors is expected to enhance digital fluency among faculty members. However, Kelsey and D'souza (2004) established that faculty perceived technology, when used as a medium for distance learning, as a barrier to effective instruction. Further, faculty members were satisfied with the nature of interactions between them and their students, using a mixed mode of online and face-to-

face. In addition, faculty had individual preferences and faced some barriers to interaction, and that these perceived barriers, when not addressed appropriately, easily give rise to apathy and lukewarm faculty attitude towards technology-based innovation. The implication is that unless there is positive mindset as far as uptake of technology is concerned; using it to foster an effective teaching remains a mirage.

Utilization of Technology in Teaching and Learning

The driving force behind adoption of educational technologies in universities is the belief that they improve quality of teaching. The pedagogical use of technology has become ubiquitous in the last twenty years, with scholars observing that technology is an integral part of providing a high-quality education. This therefore calls for faculty to acquire specific technology skills to foster effective teaching (Friel et al 2009).

Transformation through utilization of technology tools has not had the same far-reaching and sustainable effect on higher education. Instead, there have been isolated pockets of success and good practice, low-level and often administrative usage, as well as the lack of an educational rationale in most educational technology integrations (Conole & Culver 2010; Kirkwood & Price 2014; Selwyn 2014**)**.

The pressure faced by faculty is coming from administrators trying to keep up with new technological advances, from students who are becoming increasingly insistent that technology be integrated in their courses. Faculty members adopt online technology either into face-to-face (Sun 2004), hybrid (Sands 2002), blended (Saunders 2003), or mixed delivery courses. However, despite the belief by many that technology can transform teaching and learning, its use is still mainly low-level: uploading lecture resources and keeping track of student assignment submissions. In the high-pressured and performance-based university environment, not all lecturers are able to find the time to explore the potential of educational technology to engage students while enhancing learning, assessment of students' work, and evaluation of teaching and courses.

Challenges in Uptake and Utilization of Technology

Teacher educators have often fallen short in their efforts to plan, model, and implement the right combination of technology experiences across the entire scope of a teacher preparation program. Most teacher educators need additional support structures to assist them with technology integration efforts (Goktas et al., 2009; Polly et al., 2010).

Much has been written about faculty resistance to technology adoption in higher education (Mumtaz, 1999). Some of the resistance stems from faculty concern about the resources to develop quality courses (Allen & Seaman 2008). Other barriers to technology adoption relate to lack of compensation for curriculum development as well as lack of recognition for embracing new technological pedagogies in tenure and promotion decisions (Grosse, 2004). Additional frustration comes from a lack of technology infrastructure, such as slow Internet connections, inadequate hardware and software, and low levels of technical expertise among instructors (Nkonge & Geuldenzolph 2006).

In South African higher education, the challenges of technology use in education are evidenced by poor internet access in some universities, scarce educational technology support expertise, the lofty aspiration to use educational technology to open up access for previously marginalised groups (Ssekakubo, Suleman, & Marsden 2011) and a lack of an educational technology policy at the national level (Czerniewicz, Ravjee, & Mlitwa, 2006). Indeed, assisting faculty to integrate technology into their teaching is considered by some to be one of the most important issues facing campus technology planners given the size of the investment in instructional technology in higher education. Blair et al (2011) asserts that faculty training often takes a toolism approach. Further, McGrath and Guglielmo (2014) are of the opinion that this type of training is of little benefit to faulty as workshops focus on how to work the tools instead of how the tools can be used to support teaching and learning. This means that uptake is not promoted due to the theoretical approach that many workshops propagate. Higher education institutions must begin to recognize the relationship between theory and practice in educating our educators and develop robust faculty development programs that endure over time.

Methodology

The study employed a descriptive survey design. The target population was all the 144 faculty members, 2000 post graduate students specifically those undertaking master's and doctoral studies, in the school of education Kenyatta University. Purposive sampling was used to select the school of education at Kenyatta University by the virtue of being the largest school that trains teachers in East and Central Africa. Simple random sampling was used to select four departments out of the seven that comprise the school of education, Kenyatta University. A sample of 200 postgraduate students and 15 faculty members were randomly selected which constituted 10% of the total target population. According to Gay (1992) a sample size of 10% in a descriptive study is deemed to be appropriate. Data were collected using questionnaires for faculty and students. The questionnaire had both closed ended and open ended questions. Specifically the questionnaire captured the respondents opinions on two key areas of technology uptake namely perceptions and utilization of technology in teaching and learning. A five point likert scale was used for the close ended questions with responses ranging from '*strongly agree to strongly disagree.'* Validity of the instruments was determined through judgment by experts in education management and information communication technology. Cronbach Alpha was used to establish the internal consistency of the instrument with a correlation coefficient of 0.0735.

Uptake of technology comprised faculty and student perceptions (effect of technology in teaching and learning, technology skills and integration of technology) as well as faculty utilization of technology in teaching and learning (ability to design content and instructional material, use of technology gadgets and online supervision). Data was analyzed using descriptive statistics for quantitative data generated from closed ended questions while thematic analysis was used to analyzed qualitative data from the open ended question

Results

Faculty Technology Uptake

The study sought to establish faculty and student perceptions of faculty technology use in the teaching and learning. To address this objective, respondents opinions were sought on various aspects as captured in Figure1.

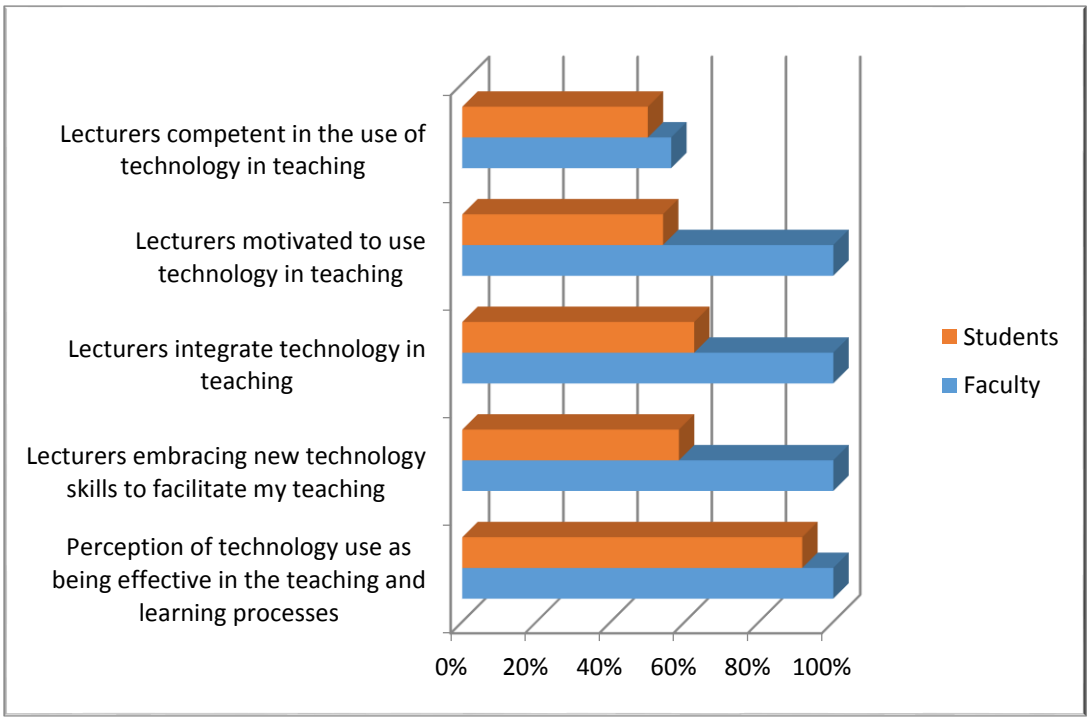

Figure 1: **Perception on the faculty uptake of technology in the teaching and learning**

The study found that faculty, (100%) perceived technology as being effective in the teaching and learning and that, they willingly embraced new technology skills to facilitate their teaching. Similarly, all faculty respondents were interested and motivated to use technology in their teaching since this had the potential to improve and enhance teaching experiences. This finding contrast with the student observation where only 40% were of the opinion that faculty were motivated to use technology in teaching implying that some of the faculty members were still comfortable with the traditional approach to teaching as noted by James (2008) who observes that fewer academics utilized ICTs suggesting that it was less effective that the traditional pedagogic approaches.

However significant, to note is that the study established that 56.3% of the lecturers felt they are able to efficiently use technology in their teaching, while the other 43.7% were either indifferent or felt deficient in the use of technology in their teaching. This could be attributed to lack of adequate skills as asserts Onasanya (2010) observed that most tertiary institutions lecturers in Nigeria lack adequate pedagogical knowledge for effective utilization of ICT resources. This notion was further corroborated by Cross and Adam (2007) who argued that despite ICT usage having increased, most institutions did not have comprehensive institutional visions or strategies on ICT use hence to some institutions it was not a priority. The study also found that 91.6% of the

student respondents perceived technology use as being effective in the teaching and learning. However, it is only 58.4% that reported that their lecturers embraced new technology skills in teaching. This shows that from the student perspective 42.6% of faculty did not embrace technology.

A great majority of, 87.6% of the faculty were open to discussing the challenges they face in their use of technologies in teaching and learning while 12.6% were not. The implication here is that university should provide opportunities to faculty to highlight the challenges faced in use of technology in teaching and learning. This will assist the universities to come up with intervention that may address issues affecting the 43.7% of the faculty that were not able to efficiently use technology.

With regard to faculty motivation to use technology in teaching and learning all the faculty respondents indicated that they were motivated to use technology however, 54.1% of the students expressed the view that their lecturers were motivated to use technology in teaching, while 33.3% felt indifferent about the motivation levels of their lecturers using technology, and further, 12.5% felt that lecturers were not motivated to use technology in teaching and learning. The contrary opinion expressed by the students (who are the recipients of instruction) on the faculty motivation to use technology is a pointer to low technology integration. Consequently, despite its perceived and proven benefit, ICT uptake by higher education institutions for teaching and learning purposes has been below par. In the case of South Africa Jaffer, Ng'ambi and Czerniewicz (2007) have opined that the potential use of ICTs in addressing teaching and learning needs is difficult to authenticate. On the aspect of technology integration, 62.5% of the students perceived that their lecturers integrated technology in teaching, while 37.5% did not. This shows a gap in technology uptake among the faculty yet the University expects all faculties to integrate technology in the teaching and learning.

The second objective of the study was to assess faculty utilization of technology in the teaching/learning processes. The results are shown in Figure 2.

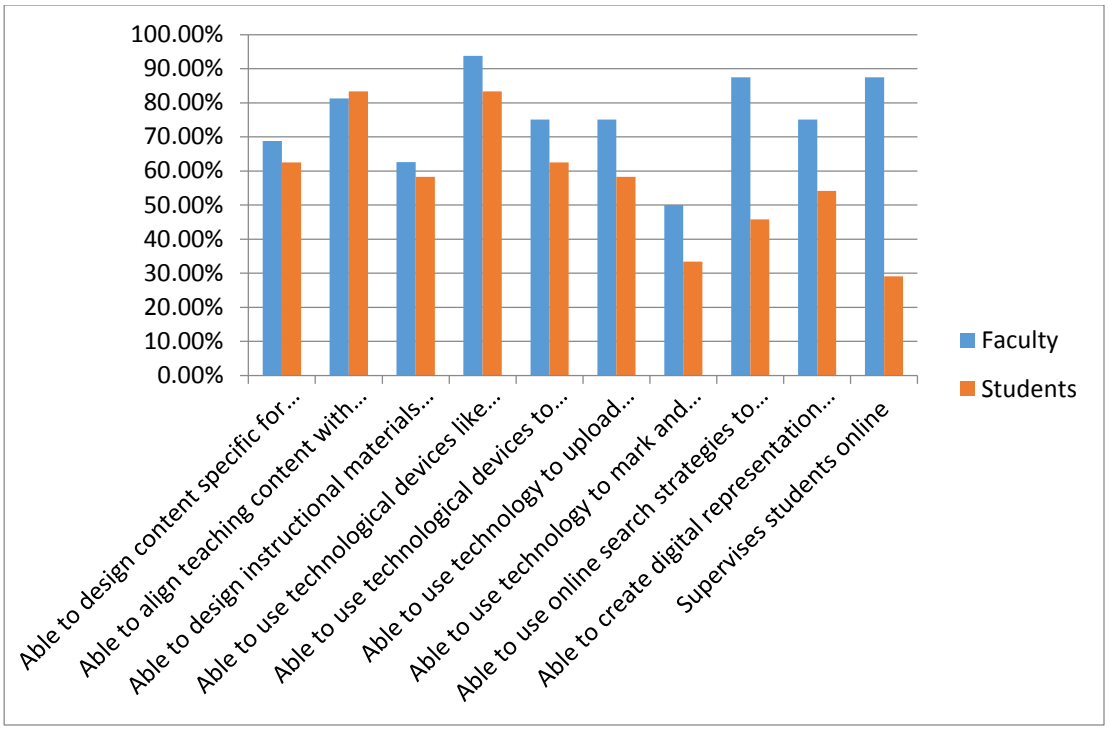

Figure 2: Utilization of technology in the teaching and learning

The study found that faculty utilization of technology in teaching was above average as shown by most of the respondents (above 50%). The study established that faculty (100%) were willing to embrace technology to facilitate the teaching and learning, but only 62.5% reported to having received adequate training on the use of technology in teaching. This agrees with Bladergroen et al. (2013) who opined that the success in ICT usage lay in training pre-service and in-service personnel and consequently the benefits will then cascade to the end user.

The findings positively showed that 87.5% were able to use online search strategies to get relevant instructional materials from suitable databases, and 75.1% were able to create digital representation of educational information tools like slide shows and videos. This is important to enhance interactivity in the teaching and learning processes. On the other hand, only 50% reported being able to use technology to mark and analyze student work. This implies that the aspect of assessment was problematic to most of the faculty members. This sentiment was also expressed by students who reported that only 58.3% of their lecturers were able to use technology to upload assessment tasks for learners. The student also observed that only 33.4% of the faculty used technology to mark and give feedback to students on time. This shows that faculty use of technology in student assessment is deficient. This is surprising in the era of increased student

numbers as notes Wisker et al. (2007) who argue that with increasing numbers of part-time and international students, supervisory relationships are likely to be conducted at a distance as students study alongside other commitments and so the use of technology is inevitable.

The greatest disparity was in the area of supervision where students reported that only 29.1% of their lecturers supervised them online, yet 87.5% of faculty reported engaging in online supervision of their students. This contrasting finding from the students implies that the issue of supervision is critical and the process being complex requires use of technology to expedite student completion. The essence of supervisors not being able to supervise online concurs with a study done in Maseno University which observed that and Supervision of eLearning students at Maseno University poses a great challenge to the normal institutional order because most senior lecturers qualified for postgraduate supervision are technologically illiterate, semi-literate, or challenged in the use of technology in the whole process (e-campus, 2019)

Challenges

Respondents were asked to highlight the challenges they faced in the uptake and utilization of technology in the teaching and learning. All the respondents cited poor internet/network connectivity especially off campus leading to low level of student participation in online engagements. The cost of internet on the part of students, while off campus was also a challenge affecting utilization technology in teaching and learning.

Inadequate training/skills were also a hindrance to the uptake and utilization of technology. Other challenges included lack of enough time for faculty to adequately prepare online tools due to high teaching workloads and supervisions.

Discussion

The study established that both faculty and students perceived technology use as an effective tool in fostering the teaching and learning. However, despite the belief by majority of the respondents that technology could transform teaching and learning, the uptake by faculty is still low-level. This resonates correctly with the sentiments expressed by some of the respondents who reported that they were not adequately trained to use technology. There is therefore need for universities to make deliberate efforts to frequently re-tool their faculties for sustainable teaching and learning that focuses on developing teachers' ICT integration skills.

The study findings were clear on low utilization of technology in the aspects of assessment and supervision of students. This may have been contributed by the high workload among the faculty in the school of education, which was the focus of the study. As noted, the challenge on internet access by students especially off campus also aggravates the issue.

Conclusion

The study concludes that all respondents (faculty and students) are of the view that indeed technology use is effective in the teaching and learning and are therefore willing to embrace it. There is however, a discrepancy in the numbers of those who have received adequate training and the numbers that report using these technologies in facilitating teaching and learning. Faculty utilization of technology in student assessment and supervision was the lowest.

Recommendations

1. The study recommends that the school of education should organize frequent deliberate in practice re-tooling sessions for both faculty and students to support uptake of technology.

2. The school of education to have infrastructural support to enable both faculty and students to utilize technology in teaching and learning

3. University management should put emphasis on faculty utilization of technology in student online assessment and supervision.

4. Since the study established a major gap in the aspect of online supervision, there is need to carry out further research on faculty capacity to utilize technology in student supervision.

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The Perspective, Pitfalls, and Prospects of Doctoral Studies in Kenya: A Critical Review

Dr. Emily Nyabisi

Abstract

The Doctor of Philosophy (PhD) still remains the highest academic qualification that marks the end, and yet another beginning, in the scholarly journey. Doctoral studies are so in-depth that by the time one is through with the studies, he or she is assumed to have become an expert in the

particular area studied. Consequently, the emphasis in Doctoral studies, as should be at any postgraduate level, is on research and not classwork. However, in most cases, students enrolled for Doctoral studies in Kenyan Universities do very well at the classwork level (coursework and examinations), but fail to transit to the research level. This implies that many of these students fail to complete their Doctoral studies within the stipulated timelines. This paper is a critical review of the perspective, pitfalls and prospects of Doctoral studies in Kenya. The paper seeks to answer the questions: Why do students enroll for Doctoral studies? What are the challenges experienced in pursuing Doctoral studies in Kenya? What are the current opportunities available for timely completion of Doctoral studies in Kenya? The issues raised in this paper and the recommendations for practice given thereafter would be significant in informing positive practices in Doctoral studies; for both the students and the institutions offering Doctoral studies; with the ultimate aim of timely completion of Doctoral studies in Kenya. As discussed in this paper, whereas students enroll for Doctoral studies for various reasons, the challenges experienced in the pursuit of these studies and the opportunities available for timely completion are in most cases similar. The recommendations made in this paper in order to address the challenges experienced by students pursuing Doctoral studies are recommendations for awareness on funding opportunities for Doctoral studies, mentorship and socio-psychological support for Doctoral students, formulation and implementation of policy on entry criteria for Doctoral studies, and development and enforcement of explicit Doctoral supervision guidelines.

Key Words: Doctoral Studies; Research; Perspective; Pitfalls; Prospects

Introduction: The Perspective of Doctoral Studies in Kenya

The Doctor of Philosophy (PhD) still remains the highest academic qualification that marks the end and yet another beginning in the academic journey. According to Kandiko and Kinchin (2012), a PhD is a long, in-depth research exploration of one topic. This implies that the PhD takes a considerably long period of time (a minimum of 3 years and an infinitive maximum in most cases); and is so in-depth that by the time one is through with it, he or she is assumed to have become an expert in the particular area studied. Therefore, the emphasis in Doctoral studies is on research and not coursework. Zeng (2013) emphasizes that research is one of the major pillars of higher education; and for a university to progress and to address the needs and challenges of the knowledge industry, academics must constantly be engaged in research. Consequently, PhD students should be trained and engaged in research that should be practical and hands-on.

However, in most cases, students enrolled for PhD programs do very well at the coursework level (lectures and examinations); but fail to transit to the research level, thereby failing to complete the scholarly journey they have started. This lack of transition is emphasized in a report by Mukhwana et al. (2016) which indicates that the rate and the numbers of Doctoral students being produced in Kenya are inadequate to meet the national needs for trained PhD holders. Sambrook et al. (2008) further allude to the problematic transition from being an undergraduate or postgraduate student on a taught programme, to a Doctoral candidate who is expected to be a novice researcher; with associated issues of developing independence and critical thinking. It is against this background that this paper critically explores literature on Doctoral studies and puts into context the perspective, pitfalls, and prospects of Doctoral studies in Kenya.

Enrolment Status for Doctoral Studies

For the past two decades, research universities across the United States, Europe and developed countries at large have been placing increasing emphasis on the importance of Doctoral education as an engine for the growth of the knowledge economy. Along the same lines, researchers in Africa have undertaken various studies to investigate the place of universities as tools for development; through Doctoral education and research. Austin (2002) argues that African universities must be encouraged to strengthen their research capacities to address the skills demands of their knowledge societies and to emerge as leaders in seeking ways to improve the quality of life of their citizens.

Such research capacity is best achieved at the Doctoral studies level. It is therefore assumed that education at this level is no longer a path of self-development for an individual, but rather, it is part of the needs of industry and the employment market of any given country.

The Centre for Higher Education Trust (CHET) criteria indicates that for a university to perform as a research tool for development, 50% of its core academics must have earned a PhD; enabling them to provide a high level of teaching and learning as well as generating more PhDs for the development of knowledge (Khodabocus, 2016). However, the results of a study that was carried out by CHET for the period 2000/2001 to 2013/2014 for seven flagship universities in Africa, including the University of Nairobi in Kenya, revealed a slow growth in Doctoral enrolments for the universities involved in the study. This contrasted with the increase in Master's degree enrolments for the same period. Results from this study indicated that not many Master's degree graduates move on to enroll for a PhD after completing their studies. For the period of study (14 years), there were only 3,538 Doctoral graduates from the seven universities involved in the study. This revelation is supported by data collected by Mukhwana et al. (2016) which shows that in Kenya specifically, Post-graduate student enrolments still remain small at only 11.9% of the total universities student population. This means that out of all the students enrolled in universities in Kenya, only 11.9% of them are enrolled for either Masters or Doctoral Studies. As of the year 2015, the PhD enrolment was only 1.3% of the total student population. There were 55,461 students enrolled in Masters Programmes and 7,146 in PhD programmes in 2015 in Kenya, as compared to 475,750 undergraduates enrolled during the same period of time.

Why Enroll for Doctoral Studies?

The motivation of doing the PhD is what will ultimately get the Doctoral student beyond the rough patches in the PhD journey and on to timely completion. Understandably, the reasons for enrolling for Doctoral studies are as varied as the individuals pursuing such scholarship. For some, it is a simple matter of status. Just the thought of having a title before or after one's name; on business cards, invitation cards, and signed documents, can be very alluring for some individuals. In addition, Churchill and Sanders (2007) point out to a more functional reason for enrolling for the PhD as the need to enhance career prospects, progression and development in existing and new occupations. The frustration of failing to get a job on the basis of the Undergraduate and Master's

degree can propel one to enroll for Doctoral studies. As is the scenario in most job advertisements nowadays, some job vacancies seek for individuals with higher academic qualifications, by indicating that such qualifications are an 'added advantage.'

According to the United States (US) Bureau of Labor Statistics, jobs requiring a Master's degree are projected to increase by 22% by the year 2020, while positions requiring a Doctoral or professional degree will increase by 20% (Khodabocus, 2016). The implication is that one may already have a job, but would still consider Doctoral qualification as a route for quicker promotion and specialization. For instance, for those who desire to be 'academics' and teach at the University, the PhD is an inevitable requirement. The declaration in 2014 by the Commission for University Education (CUE) in Kenya; that only PhD holders will be allowed to teach at the university as lecturers, is a good example that must have sent many to enroll for Doctoral studies (Ng'ang'a, 2014). As the knowledge economy grows, more careers needing Doctoral education will emerge in Africa, and academics holding a PhD must therefore be motivated and guided to produce more Doctorates who will further strengthen and empower the labour force.

However, the overriding reason for enrolling for Doctoral studies should be the joy of research, which translates to the joy of discovering something new (no matter how small), and the joy of truly understanding something in existence. Churchill and Sanders (2007) observe that scholarship at the PhD level should be pursued for the sake of scholarship; for the love of knowledge, for the curiosity to unravel the mysteries hidden in 'books' and the desire to get solutions to the myriad challenges that afflict society. This implies that research should be at the heart of scholarship, and should be the main reason for pursuing the PhD. Though the passion for the topic of research that one desires to study is not always clear cut from the start; it should always be vaguely at the background of the decision to enroll for PhD. Cassuto (2010) further recommends that from the beginning, the PhD student should work on a topic that they are truly excited about and are interested in.

Unfortunately, in many developing nations, Kenya included, Doctoral studies are seldom pursued for scholarship sake. Consequently, most scholars never conduct research or engage in any scholarly pursuits after earning their PhDs**.** Rugg and Petre (2005) argue that for such people, the

scholarly journey was largely a waste of time and resources. However, those who successfully pursue Doctoral studies - for whatever initial reasons - and in the process fall in love with the joy of research, are able to look back and laugh over their naivety in the initial reasons for enrolling for the PhD. These are the individuals who are able, in the long run, to overcome the pitfalls involved in Doctoral studies.

Pitfalls in Doctoral Studies

The path towards obtaining a PhD degree can be challenging and full of uncertainties; thus, success is not definite. The context and conditions in which Doctoral studies take place have a significant impact on the process and the end result. A study by Skakni (2018) reveals an enduring perception of Doctoral studies as an 'initiatory trial' that affects both the formal and tacit organization of the process, and consequently its underlying challenges. Thus, the scholarly journey as embodied in the PhD is fraught with many challenges that would make one question the wisdom of enrolling in the first place; or even despair before completion. Four of these challenges that any Doctoral student should look out for are discussed herein. These are challenges that were evidenced in most of the literature reviewed for this paper and are challenges concerning finances, time, capacity and supervision in Doctoral studies

Finances

Austin (2002) contends that lack of finances is a major constraint to earning one's PhD. Some individuals once enrolled for Doctoral studies cannot afford the high fees charged for the program. Some complete coursework but cannot afford the costs of conducting research. Where no financial breakthrough comes for such individuals, they end up dropping out of the program. In most cases in developing countries, opportunities for government financial support or scholarships for Doctoral studies are too few to benefit all those who desire to pursue such studies. Thus, for the benefits of Doctoral studies to be realized, increase in support must be provided for research-performing institutions, with a more stable model for funding research-based Doctoral programs. Universities should also strive to increase their research grant portfolios by attracting increased funding from Government, the private sector, development partners and international organizations; for the benefit of their Doctoral students. Mukhwana et al. (2016) also emphasize that research funding flows to research areas that are relevant to, and support, the realization of national development goals. Universities should therefore strive to align their research agendas to

national priorities, so as to strategically position their researchers, including Doctoral students, to benefit from such funding.

Time

Doctoral studies require a lot of dedication in terms of time spent poring through information, conducting one's study and compiling a research thesis. The lack of time for most African scholars is compounded by the fact that there are other aspects requiring the student's attention such as career, family, and business interests. Consequently, it is important that one should feel passionate enough about the PhD, from the start, to make significant sacrifices of their time. This is because taking a PhD implies making changes to personal, social and work life (Rugg & Petre, 2005). Additionally, most individuals in developing countries begin to think about postgraduate studies at an advanced age; after sorting out all other things in life. Amutabi (2017) observes that most PhD graduates in Kenya tend to be of advanced age - in their 50s and 60s. This implies that the graduates have less than twenty years of active scholarly service as compared to developed countries where the average age of PhD graduates is about 28 years. In Kenya, an individual enrolling for Doctoral studies at a younger age is often dismissed as being too young and in a hurry, as obtaining a PhD at an advanced age seems to be the rule rather than the exception. There are also those individuals who are victims of the long time taken to complete their Doctoral studies even after enrolling at a relatively younger age.

Capacity

At the PhD level, an individual is offered structured opportunities to make critically informed connections between their own values and the research in their field of study**.** In conducting research, therefore, the Doctoral student should be able to experience new ways of thinking, and achieve critical autonomy in recognizing how philosophy impacts on their study (Kandiko & Kinchin, 2012). Unfortunately, some students who enroll for Doctoral studies are devoid of critical academic scholarship. Such students, even after earning their PhD, lack the capacity to become the big-thinkers and creative problem solvers that society needs. This unfortunate situation is further compounded by the willingness with which some Doctoral students plagiarize previous studies done by other scholars, or resort to hiring the services of commercial 'professionals' in research

and thesis production. This, according to Sutherland (2005), is academic dishonesty that results in some students graduating with a Doctorate, but without the

Philosophy in it. Few evaluation systems and quality control mechanisms are in place to ensure the quality of Doctorates in developing countries. CHET studies reveal that African labour markets and governments do not systematically evaluate the competencies of PhD holders, or the relevance of what they can contribute to society (Khodabocus, 2016). Therefore, Universities need to review their model of offering Doctoral studies to ensure that the outcomes match skills requirements for the academic, industrial, public and private job markets.

Supervision

Doctoral supervision is a complex process, and the relationship between the Doctoral student and their supervisor is in most cases the most crucial variable that affects how the PhD journey is experienced and how it ends. Personal compatibility is an important aspect of the supervisor-student relationship; and it can either make or break the PhD experience (Wadesango, 2011). Among the rigors of supervision at the Doctoral level is having to contend with cancelled supervision appointments, unclear expectations or comments by the supervisor, or feedback given at the supervisor's discretion - often delayed. Most senior academic staff who supervise PhD candidates are over-burdened with commitments, many of which take them away from their supervisory duties. In as much as supervisors may be committed to improving the supervision process, the growing numbers of students they are required to supervise and the lack of time allocated to provide adequate supervision is also a genuine concern. Amutabi (2017) further argues that some supervisors delay or fail students because of their own internal wrangles with co-supervisors. The supervisor may also reflect on their own supervision experience as a student; and therefore bring pre-determined, sometimes unrealistic, expectations to the supervision process. The challenges students face in the research supervision are often made more difficult by the fact that supervisors have tacit knowledge of the features and approaches to research that they do not explicitly communicate to students (Bitchener & Basturkmen, 2006). A study by Regis (2012) found out that research supervision would be improved if: supervisors received training in research supervision; all supervisors employed a guiding attitude; the university adopted a common research supervision guideline; student and supervisor met/communicated regularly; and if students chose their own supervisors. Manathunga (2005) further observes that institutions

offering Doctoral studies should ensure that their quality of supervision reaches the appropriate standard and also put in place procedures to allow students to change their supervisors if after making considerable effort, the student-supervisor relationship is simply not working.

However, Doctoral students also often complicate the supervision process. For instance, students whose supervisors are younger than them would want to supervise rather than be supervised by the supervisor. This attitude where a student perceives that they are more knowledgeable than their supervisor is a serious pitfall that must be avoided by those who wish to complete their PhD on time. Whereas it is acceptable to have a healthy discourse on ideas with one's supervisor, blatant contempt or disregard of the supervisor's guidance should be avoided. As McCallin and Nayar (2012) emphasize, when you register as a Doctoral student, you must identify yourself as a learner. Being a learner gives you permission not to be an expert**,** but to question your own assumptions and the assumptions of others, and to explore the familiar from new perspectives. There are also instances of Doctoral students who expect supervisors to do the research work and write or dictate the research thesis for them, word for word, in the process of supervision. A study by Lumadi (2008) reported that supervisors often complained that students were poorly prepared for the research dissertation, failed to take their comments and feedback into account when revising their dissertations; and that poor language skills on the part of many students meant that the supervisor had to spend a great deal of time on editing and correcting the students' work.

Prospects for Doctoral Studies

For most students who do Doctoral studies for the right reasons, it is usually an exciting and positive experience despite the pitfalls discussed above. For such students, even the most trying of situations during the academic journey provide an opportunity to work to prove that one can persevere through to the end. Cassuto (2010) observes that most of such individuals would welcome the challenge of earning their Doctoral degrees all over again. This is especially so because of the current prospects available for those pursuing Doctoral studies. As highlighted herein, these prospects are in reference to technology, funding opportunities, and mentorship from senior scholars.

Technology

Information Communication Technology (ICT) has been singled out as a key component of transforming learning and training environments (Mohamedbhai, 2015). Most scholars who undertook their Doctoral studies in the 1970's and 1980's would attest to the struggle of getting literature to support their studies. In most cases, even confirmation of similar studies done by other scholars required endless physical visits and searches in various institutional libraries. This contrasts to the current situation where through ICT, scholars can get access to a range of information at the click of a button, even from the comfort of their homes. Doctoral students can source for information from online journals and books; and also disseminate their research findings through the same e-journals and books. Use of ICT also includes the opportunity to type, save, proof-read, and edit one's work on a personal computer; as opposed to a manual typewriter in an office; as was the case for earlier researchers (Sigafoos & Green, 2017). However, most Doctoral students lack knowledge on how to fully utilize ICT in their studies; and this should be a key concern for institutions offering Doctoral studies.

Funding opportunities

Phillips and Pugh (2005) point out that a wide range of research grants are available to those Doctoral students who know 'where to look'. Such grants include funding to conduct research in particular fields of study that are of interest to the funding organization, or grants given to students of a particular gender, especially women; or students from particular parts of the world, especially countries that are still considered underdeveloped or developing. Other grants support particular aspects of the research process; such as library visits for literature review, data collection, or dissemination of research findings in conferences or through publication. Some grants given to senior researchers may require that at the end of the funding period, the grants given must have supported a given number of students at Doctoral level to completion. Nerad and Heggelund (2008) point out that the challenge for institutions offering Doctoral studies is creating awareness of, and linking Doctoral students to, relevant funding opportunities.

3.3 Mentorship

Budding scholars - exemplified in students enrolled for Doctoral studies - should, and can, easily be mentored by senior scholars who have successfully walked the scholarship journey. Eley (2005)

and Maxwell and Smith (2010) underscore the importance of providing opportunities for Doctoral students to participate in workshop based activities with other academicians and mentors so as to develop intellectual and social collegiality. Senior academic staff can also work collaboratively with such budding scholars on publications and conference presentations resulting from collaborative research. Saari and Moilanen (2012) point out that due to the availability of ICT, including the internet, such collaboration has become increasingly easy at both the national and international levels. It is also critical for senior academics who supervise Doctoral students to be friends rather than foes during the supervision process. Wisker (2005) emphasizes that ultimately, it is critical for scholarship to be demystified, especially at the PhD level. Scholars who have successfully completed the PhD journey should make the budding scholars enrolled for Doctoral studies know and believe that the PhD is not a mystery, but is something achievable that can be earned through tremendous perseverance and hard work. It is the gratification and enlightenment, rather than the challenges, of the PhD that must always be emphasized at all times to the students enrolled for Doctoral studies.

Conclusion

Whereas the motivation for pursuing Doctoral studies are as varied as the individuals enrolling for these studies, the challenges experienced by students pursuing Doctoral studies in Kenya are in most cases similar. Key among the challenges experienced are lack of finances to meet the cost of Doctoral studies, lack of time to effectively pursue Doctoral studies, lack of critical academic capacity to pursue Doctoral studies and challenges to do with supervision of one's research; which is the main component of Doctoral studies. However, there are also current prospects available for students pursuing Doctoral studies to enable them complete their studies on time. These prospects include use of ICT, availability of a wide range of funding opportunities, and mentorship by senior scholars who have already earned their PhDs.

Recommendations for Practice

Based on the review of the perspective, pitfalls and prospects of Doctoral studies discussed in this paper, the following recommendations for practice are made:

i. Universities should create adequate awareness of available funding opportunities for Doctoral studies. There should also be mechanisms for guiding students enrolled for Doctoral studies on the applicable procedures for securing such funding.

ii. Students enrolled for Doctoral studies should be mentored on the rigors involved in obtaining the PhD. Universities should put in place adequate socio-psychological support mechanisms to sustain students who may want to give up along the way. The four-year completion rule should also be enforced and monitored across institutions.

iii. Universities and other Higher Education stakeholders should institute policy on entry criteria for Doctoral studies; in addition to the possession of a relevant Masters degree. Such criteria should allow the institution to determine the capacity of the students enrolled for Doctoral studies. Where students lack capacity in certain areas, such as ability to use ICT for research, pre-training on these areas should be given before the students embark on their research.

iv. Universities should develop and enforce supervision guidelines that ensure that their systems check on supervisors' performance. These guidelines should be explicit and should be made known to both the Doctoral students and the supervisor. PhD supervisors should also be trained to go beyond supervision and become mentors to the students they are supervising.

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Mineralogical and Morphological Properties of Matisaa Gray Rock as a Possible Raw Material for Manufacture of Cement

Geoffrey Mwendwa, Fredrick Otieno, & Isaac Motochi

Abstract

Matisaa is a semi-arid area in Mwingi West, Kitui County, Kenya where a unique rock that the locals refer to as Matisaa gray rock is found. Matisaa gray rock is thought to have been formed as a result of declination of live coral cover and degradation coral reef habitat. This rock portrays properties like cement. This work explores the possibility of using Matisaa gray rock as a substitute for limestone in the manufacture of cement. The relative proportions of the constituent minerals and morphology were determined using X-Ray Fluorescence (XRF) and Scanning Electron Microscope (SEM) respectively. Fundamental oxides commonly found in cement were also seen in Matisaa gray rock in the following proportions: CaO (39.03-46.42wt.%), SiO_2 *(15.68-16.79wt.%),* Al_2O_3 *(0.47-4.81wt.%),* Fe_2O_3 *(0.06-1.04wt.%), MgO (1.56-3.56wt.%),* SO_3 *(0.00-6.06wt.%),* K_2O *(0.59-2.64wt.%) and* Na_2O *(0.00-0.21wt.%). The Loss on ignition (LOI) for the sample was determined to be in the range of 29.99-36.24wt.%. Except for* SiO_2*, the proportions of the remaining oxides and the LOI for the sample were found to be within the recommended thresholds. The morphology of, Matisaa gray rock was found to be compact with block and irregular-angular grains which are agglomerated. The results obtained were found to match closely with the allied properties limestone and thus by this virtue Matisaa gray rock was regarded a possible raw material for manufacture of cement.*

Keywords: Matisaa gray rock; Portland cement; Morphology; XRF; SEM

1. Introduction

The setting time of cement is governed by the efficiency of the chemical reactions of its components. The efficiency of the chemical reactions of the components of cement is strongly

dependent on the morphology of the constituent materials' particles. (Olafusi et al., 2018) reported that the morphology of cementitious materials influences the rate of pozzolanic reaction and the reduced compressive strengths of concretes that are made with Pozzolan blended cements concretes at higher weight replacements. The suitability of cementitious materials for applications given areas is attributed to the concentration of their cement essential mineralogical composition whereas the overall behavior of the resultant cement requires a comprehensive knowledge of the materials' composition and morphology ("Portland Cement - Determining Particle Size and Shape," 2019). The study of these properties is thus an essential step in the characterization of the raw materials of cement. Cement raw materials are scarce and their high rate of depletion has resulted to increasing cost of cement and consequently poor delivery on affordable housing and infrastructural development in developing economies (E.D, S.S, P.W, & O.F, 2017). These gaps call for research in exploration of alternative materials that can substitute/ replace them in manufacture of cement without compromising its quality. The potential to diversify the raw materials of cement is anchored on their availability (Korkmaz, 2019).

Cement raw materials are composed of Ca and Si as the major elements and Al, Fe, Mg, K, Na, Ti, and Mn as the minor elements. Akpan et al. (2011) specified the certified concentrations of standard limestone as shown in Table 1.

Table 1
Certified elemental concentrations (ppm) of limestone

Element	Concentration (ppm)
Ca	562 000.8
Si	272 850.0
Al	60 290.0
Fe	11 416.0
Mg	0.0
K	2 764.0
Ti	1 175.4
Mn	322.4

Generally, the mineralogical composition of cement and its raw materials is presented as oxides (Kamau *et al.*, 2016). These oxides include lime (CaO), silica (SiO_2), alumina (Al_2O_3), magnesia (MgO), iron oxide (Fe_2O_3), sulphur trioxide (SO_3), sodium oxide (Na_2O) and

potassium oxide (K_2O). Each of the aforesaid oxides performs unique function during cement hydration and should fall within the concentration values recommended by given standards of that country (Bouazza *et al.,* 2016). Some of the renowned raw materials have been certified to manufacture cement include limestone (known for high lime content), clay (known for high silica content), bauxite ore (known for high alumina), iron ore (known for high iron oxide) and mudstone (known for high lime and silica content). The effectiveness of these materials in the manufacture of cement is dependent on their physical and chemical properties as well as their origin. The Civil & Engineering, 2012 provided the oxide concentration of standard limestone (see Table 2).

Table 2
Oxide composition and concentration (wt.%) of standard limestone

Name of Oxide	Minimum	Average	Maximum
CaO	38.0	40.0	42.0
SiO_2	20.0	22.5	25.0
Al_2O_3	2.0	3.0	4.0
$Fe_2O_3 + MgO + SO_3 + K_2O + Na_2O$	1.5	2.0	2.5
LOI	30.0	31.0	32.0

In this paper, the concentration of the fundamental oxides of cement along with the elements present in Matisaa gray rock deposit as well as the morphology were evaluated in order to assess its suitability as a possible raw material for cement manufacturing. Matisaa gray rock reveals unique physical properties which are ascribed to cementitious materials. For instance, it is used by the local community to construct rock-filled gabion structures. It has fine particles that get embedded to the lining of the gabion wire mesh in the presence of moisture thereby reinforcing the stability of the structure. The soft Matisaa gray rock is sometimes used by kindergarten pupils for modelling clay objects. These properties are regarded cementitious properties of Matisaa gray rock. The results of this work were cross-validated with the other related studies in order to conclude.

2. Materials and Methods

2.1. Materials

Matisaa gray rock used in this research was sourced from Matisaa gray field, Mwingi-West District, Kitui County (Kenya). Matisaa gray rock was washed with distilled water to remove any surface contaminants and dried in an oven at 105^0C for 1 hour. The rock was then ground into a size of approximately 2mm-45μm using laboratory mill. The powder was sampled by quartering method and further dried in an oven at 110^0C until there was no further change in mass. The sample was then ground into fine homogeneous powder using Bico pulverizer machine to a maximum size of 150μm. The powder was then transferred to a ball mill which set to grind the sample for 30 minutes at 200 revolutions per minutes (rpm) to nano-scale size. The sample was placed in a 22mm aluminum cup and hydraulically pressed into pellets under a force of 10 000N for 60 seconds to ensure surface consistency under vacuum conditions. Figure 1 outlines the sample preparation steps.

(a) (b) (c) (d) (e)

Figure 1: Sample preparation steps: (a) Matisaa gray rock deposit, (b) Cleaned portion of the rock, (c) Rock broken into grindable size, (d) Rock ground into powder and (e) Powder pressed into a pellet (diameter =22mm).

2.2. Characterization of Matisaa gray rock

The chemical and morphological properties of Matisaa gray rock were examined and reported. The mineralogical characteristics of Matisaa gray rock was characterized using Herzog XRF spectrometer (Model D-49086). The working principle of XRF spectrometry lies on the emission (fluorescence) of characteristic X-rays photons from a sample that is being excited. The elements present in the sample are identified and quantitated by determining the energies and the number of emitted photons respectively. The morphological characteristics Matisaa gray rock was examined by a Field Emission Scanning Electron Microscope (the ZEISS Ultra PLUS FEG SEM Microscopes types) with an accelerating voltage of 15 kV and a working distance of 12.5 mm. The

sample was coated with a thin layer of gold in a gold sputter coater to enhance the conductivity of the sample and improve the optical resolution of the micrographs.

3. Results and Discussion

3.1 Mineralogical Properties of Matisaa gray rock

The results of the XRF qualitative and quantitative analyses of the elements in the Matisaa gray rock sample are as shown in Tables 3 and 4.

Table 3: Elemental concentrations (ppm) of Matisaa gray rock

Element	Concentration
Ca	294 000
Si	45 200
Al	16 700
Fe	3 940
Mg	3 990
K	3 290
Ti	809
Mn	190
Ca	294 000

Though Matisaa gray rock contains the main limestone elements, the concentration of the individual elements varies considerably as depicted in Table 3. The cement oxide concentrations of Matisaa gray rocks are shown in Table 4. According to (Civil & Engineering, 2012), Matisaa gray rock contains all the major oxides (CaO, SiO_2 and Al_2O_3) and minor oxides (MgO, Fe_2O_3, SO_3, K_2O and Na_2O).

Table 4

Oxide composition and concentration (wt.%) of Matisaa gray rock

Name of Oxide	Minimum	Average	Maximum

CaO	39.03	42.73	46.42
SiO_2	13.92	15.36	16.79
Al_2O_3	0.47	2.64	4.81
Fe_2O_3	0.06	0.55	1.04
MgO	1.56	2.56	3.56
SO_3	0.00	3.30	6.06
K_2O	0.59	1.62	2.64
Na_2O	0.00	0.11	0.21
LOI	29.99	33.12	36.24

The oxide composition of the other critical minerals (CaO and MgO) was also found meet the threshold amounts requirement. CaO oxide should be at least 38wt.% for beneficiation to be possible ("Limestone Threshold Value," 2016.), whereas MgO, the most deleterious mineral, should not be more than 7wt.% ("Building lime Public Review Draft, 2010). The alkaline oxides; K_2O (0.59-2.64 wt.%) and Na_2O (0.00-0.21wt.%) and CaO (39.03-46.42wt.%) met the minimum required concentration. Both of these are crucial in providing concrete compressive strength. Fe_2O_3 levels (0.06-1.04 wt.%) were also in the range of required values (1.5-2.5 wt.%) (Civil & Engineering, 2012). Above 10.0 wt.%, ferric oxide accelerates the setting time of concrete that develop without fine structure (Fortes *et al.*, 2016). According to Kenya Standard of building lime, MgO (1.56-3.56 wt.%) is expected to have a maximum limit of 7.0wt.% ("Building lime Public Review Draft, 2010). The concentration of SO_3 (0.00-6.06 wt.%), which regulates the setting time of cement was also found to be within the recommended level Kenya Standard of building lime (3-7wt.%) ("Building lime Public Review Draft, 2010). Higher levels of SO_3 above the specified limits accelerate setting time thus inhibiting proper molding of the resultant cement admixture. The concentration of SiO_2 (15.68-16.79wt.%) of Matisaa gray rock was comparable to that of Upper Permian (NW Iran) limestone (11.12-15.82wt.%) as found by Abedini & Calagari, 2015. However, this is below the certified limits. This shortcoming can be overcome by beneficiation. Beneficiation is an industrial process performed to enrich the minerals to their required levels. The

loss on ignition was found to be in the range of 29.99-36.24wt.% which is in agreement with the range of the LOI of typical limestone, (30-32 wt.%) (Civil & Engineering, 2012). The result of the oxide composition indicated that Matisaa gray rock is a class C Pozzolan, with an aggregated sum of silicon dioxide, aluminum oxide and Ferric oxide at 61.15wt.%, which is higher than the required 50% specified by ASTM (2015); where a Pozzolan is classified as Class C pozzolanic material when the sum of the composition of SiO_2, Al_2O_3 and Fe_2O_3 in the powder exceeds 50% and class N when their composition exceeds 70wt.% (Abualrous, 2017).

3.2 Morphological Properties of Matisaa gray rock

The morphology of Matisaa gray rock observed by the SEM micrograph shown in Figure 2 indicates that its particle exhibits block and angular shapes with a wide range of particle size distribution and agglomeration of some particles. Additionally, the compact morphology of the particles indicates that that Matisaa gray rock is less porous. The micrograph shown in Figure 2 corresponds to the one that was reported by Marie *et al* and implies possible agglomeration of Matisaa gray rock in hardened concrete composites (Marie & Berodier, 2015).

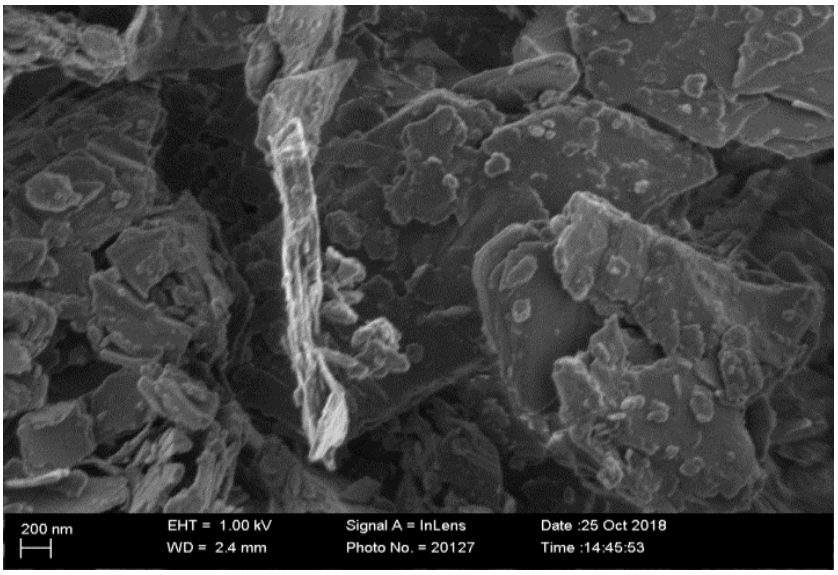

***Figure 2*: Morphology of Matisaa gray rock**

4. Conclusion

Matisaa gray rock was found to contain the following major oxides of cement: CaO followed by SiO_2, Al_2O_3, and then Fe_2O_3 in that order. Among the minor oxides that were present in Matisaa

gray rock include MgO, Na_2O, K_2O and SO_3. The results obtained were found to match closely with the allied properties limestone and thus by this virtue Matisaa gray rock was regarded a possible raw material for manufacture of cement.

Data Availability Statement

The authors confirm that all data supporting the findings of this study are available within the article.

Conflict of interest

The authors declare no conflict of interest.

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