THE INFLUENCE OF CURRICULUM IMPLEMENTATION ON MASTERS' STUDENTS' USE OF STATISTICS IN RESEARCH

Joseph M. Mubichakani[1*], Kitainge, M. Kisilu [2] and John Simiyu[3]

1 Lecturer, Science Education Department University of Eldoret
P.o Box 1125 – 30100 Eldoret, Kenya
Email: joemukuyuni@gmail.com

2 Associate Professor, Technology Education Department University of Eldoret
P.o Box 1125 – 30100 Eldoret, Kenya

3 Professor, Technology Education Department University of Eldoret
P.o Box 1125 – 30100 Eldoret, Kenya

ABSTRACT

Knowledge is attributed to successful innovation in firms and research has been identified as the main source of knowledge. University students in Kenya have been accused of doing low quality research. One of the major components of research is data analysis that is either qualitative or quantitative. In quantitative analysis statistics is majorly used. Statistics starts at the planning stage to establish the design and sample size all the way to data analysis. However, simple statistical notions are sometimes misunderstood or misinterpreted by research workers in many disciplines who have limited knowledge of statistics. The purpose of this paper was to determine how the masters' curriculum implementation meets the needs for use statistics. The study used descriptive survey design complimented with case study design. A total of 83 respondents from 3 different universities participated in the study. Frequencies and regression analysis were used to analyze data. The study exposed flaws in training of researchers in use of statistics. The study therefore noted that adequate training based on a rich curriculum in statistics is essential to use statistics in research.

Keywords: Curriculum Implementation, Statistics, Research

1. INTRODUCTION

Knowledge is an important aspect in any given society. Yamamoto (2001) noted that knowledge is valued as a vital asset for progress and prosperity in every sphere of human understanding. Given this importance of knowledge it's prudent that sources of knowledge are identified and protected. Review of documented literature identifies research as a key source of knowledge (Yamamoto (2001); Estabrooks, et al (2005); Assimakopoulos, & Yan (2006) & Fletcher & Harris (2012)). The review also established that universities are the main centres of research and training researchers (Clark (1993); Votruba (1996); Sawyerr (2004); Cloete & Maassen (2015) & Mukhwana et al (2016)).

Since research and research training is core in generation of knowledge, it is expected that every university should be striving to perfect it. However, this is not the case for African universities. African universities are still struggling in research (Musiige & Maassen, 2015). In a count of Web of Science journals, Africa has only 101 journals out of the estimated 14,000 journals worldwide. This translates to 1% of the journals (Tijssen, 2015). Tijssen also noted that the contribution of University of Nairobi, Kenya, towards published research work was slowing down. Scott (2015) and Mukhwana et al (2016) attributes this to poor quality research in Kenya.

Statistics has been identified as a key concept of research. Statistics in research enables one to; Plan for research; Produce data that provide clear answers to important questions; and Draw trustworthy conclusions based on data (Bishop & Talbot (2001); Sprent (2003); Zwiers & Von Storch (2004)). Inadequate understanding of statistics and/or misinterpretation of statistics has been noted to lower the quality of research findings (Murray (1991); Maindonald (1999); Svensson (2001) Bishop and Talbot (2001); Sprent (2003)). Literature review noted two main causes of inadequate understanding of statistics and/or misinterpretation of statistics across Asia, Europe and America. One of the causes identified was research being carried by non statisticians (Glencross & Binyavanga, 1997); and secondly inadequate training in use of statistics in research (Harraway, et al 2001). The causes of low quality research in Kenya remain unclear but can be hypothesized to be caused by inadequacies in use of statistics as it has been found out in other continents. Mubichakani (2019) noted that majority of the masters students 68.4% were finding it difficult to use statistics in research.

The guiding purpose of this study was; to determine how curriculum implementation influence post graduate students use of statistics in research, a case of universities of western Kenya. The purpose was with a view of incorporating necessary measures into post graduate students training in use of statistics to develop a knowledgeable workforce in research. The study specifically surveyed what was taught in Masters' Class in Relation to Statistics, surveyed of how the teaching was carried out in Masters' Class and the influence of Curriculum Implementation on use of Statistics in Research

2. LITERATURE REVIEW

Muia and Oringo (2016) noted that training is an important aspect of research productivity in universities. The importance of this aspect can be reflected in the curriculum set by the university but the same should also be reflected in its implementation. Votruba (1996) argued that universities that are committed to strengthening and more fully integrating outreach should be able to advance the pedagogy of outreach in order to maximize its impact. These same sentiments can be said of statistics training. Universities that are after training commitment researchers, who can comfortably use statistics, have no choice but to employ the best training strategies. Sawyerr (2004) notes that, in universities and research institutions, the capacity of individual researchers, including their skills, competencies, attitudes, and values, is developed primarily through appropriate training programs and courses and by use of strategies that involve trainees in research activity. Review of literature revealed various strategies and methods that are employed by different Universities and research institutions to implement their set statistics training curriculum. Some of these strategies are as discussed below.

Clark (1993) indicted that as a result of mass education majority of research trainees are primarily exposed to systematic, sequential course work. Harraway, et al (2001) note that one of the ways of implementing the set curriculum is requiring students to attend formal lecture courses, provided by statisticians or established researchers. Wei (2001) note that most of the Chinese universities and research institutions are using Class teaching in addition to other strategies to train researchers in statistics. This traditional form of training is wide spread across all continents. Harraway, et al (2001) noted that lecture method has been used at University of Otago, alongside offering short courses to compliment it. They, however, noted that the situation is not satisfactory. Out the staff they surveyed on this matter, 70% thought that students were inadequately prepared when they started research. Of the students, 75% thought that they were inadequately prepared. These findings cast doubts on the effectiveness of lecturer method as a way of training researchers in statistics.

Documented research findings indicated that some of the universities have complimented the lecturing strategy with a second strategy of training. The second strategy that was revealed from survey was the workshop strategy. Rossman (1997) found out that workshop Statistics was quickly gaining momentum as a statistics training technique. According to his research workshop Statistics is a project that involved the development and implementation of curricular materials which guide students to learn fundamental statistical ideas through self discovery. Classes are held in microcomputer equipped classrooms in which students spend class time working collaboratively on activities carefully designed to enable them to discover statistical concepts, explore statistical principles, and apply statistical techniques. He noted that in institutions that workshop statistics was being used, the lecture format was completely abandoned. Saville (2001) a statistician consultant noted that he normally organizes one day statistics workshops to train his colleagues and students in statistics. He indicated that he designs the workshops specifically to teach ideas rather than methods of calculation.

Mji and Glencross (2001) indicated that the University of Transkei has fully embraced use of workshops and short courses, supplemented by a variety of research seminars in the training of social science researchers. The university has gone a step further to set up a fully operational research resource center just for the purpose of training researchers. Crivisqui, et al (2001) Since the eighties, the Data Processing Methodology Laboratory of the Université Libre de Bruxelles, Belgium, in collaboration with other European universities, has been holding statistical methods seminars at the main public universities in Argentina, Bolivia, Chile and Paraguay. These seminars have mainly focused on statistical methodology and associated data processing technology, applied to sampling surveys in socio economic studies. In 1993, they note that this same program was extended to South American universities. Harraway, et al (2001) also identifies research trainees attending specialist short courses and workshops provided by statisticians or by established researchers in their disciplines as a way of being trained in use of statistics in research. In each of the cases discussed above there is record of success of the workshop strategy of training.

The third approach indicated by scholars as a way of training researchers in statistics is by consultancy. Belli (2001) in an electronic survey of 106 USA departments of statistics noted that, consulting service was a useful way for researchers to learn because they would be working on a problem or data set of interest to them. Saville (2001) noted that he teaches statistical ideas to

agricultural research colleagues mainly through everyday consultations to explain any statistical concepts that are relevant to the topic of conversation. Although not much research has been done on this strategy of consultation training, the two studies have shown positive effects of the strategy. Lastly, Harraway, et al (2001) determined that researchers also learn about statistics informally from their own reading, with assistance from established researchers. They noted that the approach seemed to be common. They further cautioned that the approach is not altogether satisfactory because it may result in the researchers having gaps in their knowledge that they are not even aware of.

The main undoing of statistics training in China was pointed by Wei (2001). He noted that in most statistical majors and training programs, the statistical courses and computer courses are offered separately. The textbooks are separately edited and published. This puts the students and trainees in a situation where they cannot solve the problems and questions using computer skillfully. In Africa Sabzwari et al (2009) notes that most teachers who are reputed in their research are unaware of the effectiveness of teaching methods. This sentiment opens up several questions on how the statistics training curriculum is being implemented in Africa and specifically Kenya.

3. METHODOLOGY

This study was based on two philosophies, the positivism philosophy and interpretivism philosophy. These philosophies differ in various aspects including their view on the nature of knowledge and reality, however, they complement each other on their weaknesses and that was the main reason for using them both. The study adopted a descriptive survey design, and the study also used a case study design to catch the complexity and situatedness of behavior among post graduate students. The two designs were adopted to meet the needs of the two different philosophies used in the study.

The study was carried out in 3 universities in western region of Kenya, 2 public and one private. The target population for the study was masters' students who had submitted their theses for examination from selected universities. To meet the requirements of the descriptive survey design, stratified and simple random sampling procedures were used to arrive at a sample of 90 masters' students that participated in the study. Purposive sampling was also used to select 4 masters' students and 3 research statistics lecturers who were taken through a detailed interview to catch the complexity and situatedness of behavior among masters' students.

Questionnaire and depth interview schedules were used in data collection. The researcher began data collection by giving the sampled students questionnaires by the researcher and research assistants. After a period of one month from the collection of questionnaires the researcher interviewed four students for in depth information. Lastly the researcher interviewed three lecturers for more information. Collected data was analyzed using frequencies and multiple linear regression.

4. FINDINGS AND DISCUSSION

The study sought to determine if and how curriculum implementation process meets the needs for students to use statistics in research. The study presented the findings based on three key sections namely what was taught, how it was taught and how what was taught and how it was taught influenced use of statistics in research.

4.1 Survey of what was taught in Masters' Class in Relation to Statistics

The study sought to determine the concepts that were taught in class. The study found out that 92.1%, 68.4% and 77.6% of the sampled respondents were taught how to determine the statistic to use, how to interpret figures and tables and descriptive statistics respectively. The study determined that 46.1% were taught inferential statistics and only 30.3% and 31.6% were taught basic computer skills and how to use statistical computer software respectively. Summary of the findings are as shown in figure 1.1 below.

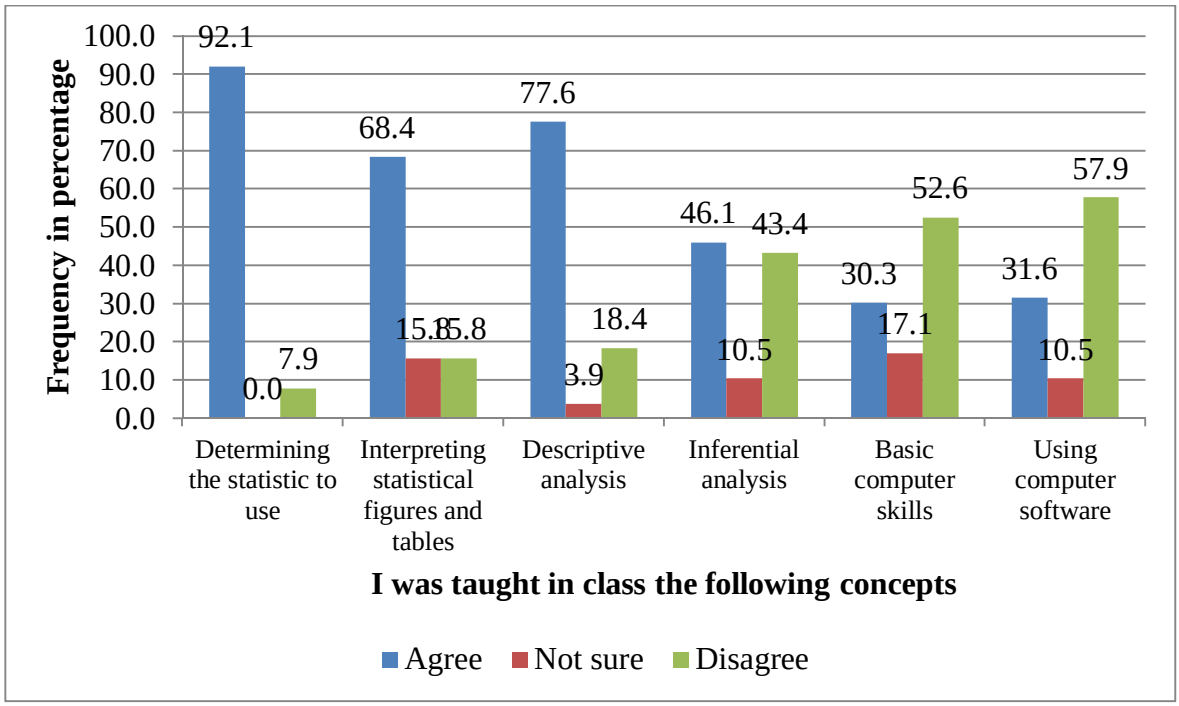

Figure 1.1: Concepts taught in Class

The study had established earlier that all the concepts in question above except for basic computer skills were in the curriculum for masters students. Despite the concepts being in curriculum inferential statistics was taught to less than half of the sampled students and use of computer software was taught to less than third of sampled students. An interview with four sampled students revealed the same picture as stated above. The interviewed students noted that some of them miss classes and never bother to make a follow up on what was taught. This explains the cases of students not knowing if a concept was taught in class or not. Interviewed lecturers noted that they rarely teach basic computer skills because they expect the learners to do it on their own. In relation to use of statistical software, which was a requirement by the curriculum to be taught, lecturers noted that in most cases they don't teach due to inadequate computers and the software itself is not availed to them by the university.

All the interviewed lecturers noted that they taught inferential statistics concepts as stated in the curriculum they were using. They, however, said in most cases they taught that manual calculation of inferential statistics and how to use the findings to test the stated hypotheses. The students interviewed confirmed they were theoretically taught concepts of chi-square, t-test and analysis of

variance among other inferential statistics. They also noted that these concepts were covered so fast and some of them had little understanding of the concepts. In one case an interviewee stated that it's just like he never learned anything despite being in those classes of inferential statistics. It came out at that point that according to lecturers they taught inferential statistics and according to students they were in those classes but about half learned little to none of the concepts of inferential statistics. This explains the discrepancy in lecturers' response and students' response on whether they covered inferential statistics.

The study findings are different from the scenario that Bishop and Talbot (2001) noted in developed countries. They noted that much of statistical education of researchers was focusing on training in specific techniques including the use statistical packages. McDonald (2001) recommended that it is important for researchers to have the opportunity either to become familiar with software commonly used with large data sets or are trained in the principles of software applications. Apart from statistical software Wei (2001) proposes that these statistical concepts including inferential statistics should be put into training materials. The study findings, therefore, means that master's students are inadequately prepared to use statistics in research. Specifically the students are not well prepared to handle inferential statistics and to use computer software for data analysis.

4.2 Survey of how the teaching was carried out in Masters' Class

The study sought to determine if the curriculum implementation process followed the recommended teaching strategies. Some of lecturers during interview noted that they have fully integrated information communication technology into teaching statistical concepts but lamented that the exercise was time consuming. The study established that 30.3% of the sampled respondents were in classes where ICT and statistics concepts were well integrated. For the remaining students the concepts were taught in isolation and in some cases they were not taught at all. The study narrowed down to these 30.3% of the students to determine how they found the process of data analysis. The study found out that 82.6% of this group found the process to be easy and 17.4% found the process difficult.

The study through interviews established that the one method that was used to teach statistical concepts was lecture method. The study also found out that 56.6%, 69.7% and 60.5% of the sampled respondents were taught determining of statistic to use, interpreting tables and figures and descriptive statistics respectively using samples of data. On the other hand only 28.9%, 26.3% and 35.5% of the sampled students were taught inferential statistics, basic computer skills and use of computer software respectively using samples of data. Summary of the findings are as shown in figure 1.2 below.

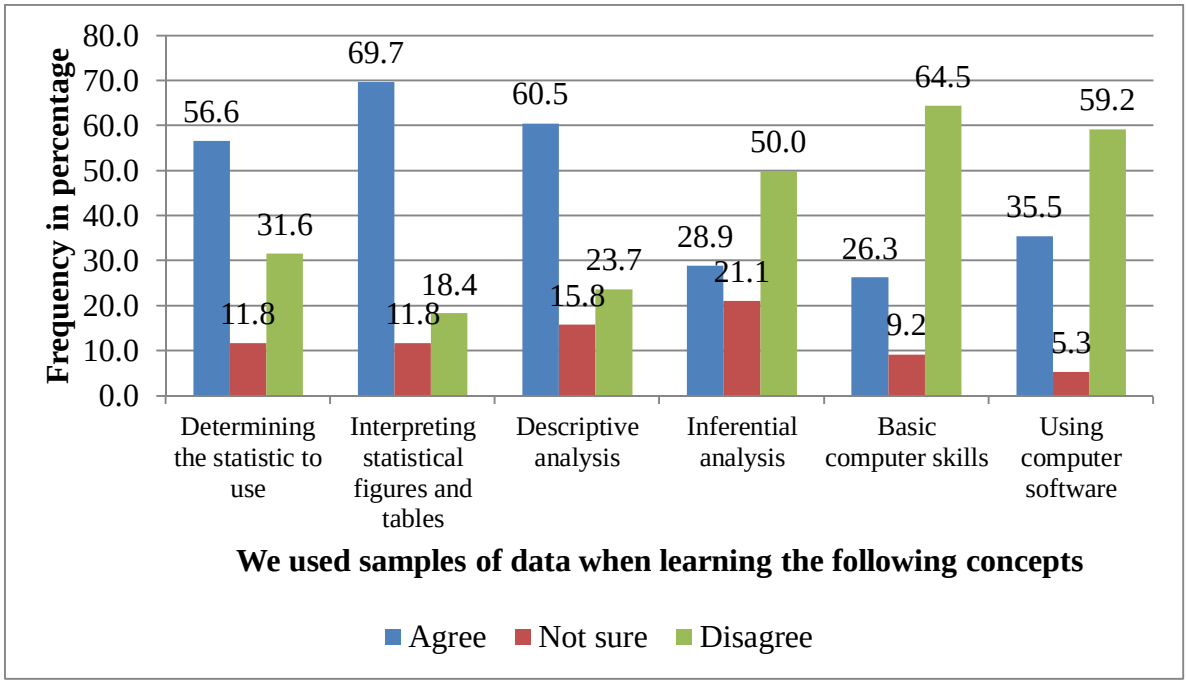

Figure 1.2: How concepts were taught in Class

The study established that just about 60% of the classes used samples of data when teaching basic statistics and about 30% used samples of data to teach inferential and ICT concepts. During interview with students they noted that the sets of data they were using during basic statistics and inferential statistics were being calculated manually with little to no use of computer software to do the same. Lecturers also confirmed teaching these concepts of statistics without use of computer software and when asked why they raised the aspect of inadequacy of computers and computer software for data analysis. These findings fall short of the requirements by McDonald (2001) who recommends practical experience with large and realistic statistical data sets during the training of researcher on how to use statistics. The findings also are contrary to findings by Sawyerr (2004) who notes that in research universities the capacity of individual researchers is developed through appropriate training by use of strategies that involve trainees in research activity. The study, therefore noted that inadequate use of sample data was a cause of inadequate training in use of statistics in research.

The study also established that lecturer method was the common method being used. This finding agree with Clark (1993) who indicted that as a result of mass education majority of research trainees are primarily exposed to systematic, sequential course work using lecture method. Harraway, et al (2001) also found out that one of the ways of implementing the set curriculum is requiring students to attend formal lecture courses, provided by statisticians or established researchers. Other researchers have however noted that lecture method alone is not adequate. Harraway, et al (2001) noted that University of Otago was offering short courses to compliment lecture method. Mji and Glencross (2001) indicated that the University of Transkei has fully embraced use of workshops and short courses, supplemented by a variety of research seminars in the training of social science researchers. The findings however indicated that these other methods that were being embraced by

other universities were not practiced in sampled universities. During interview respondents noted that workshops are occasionally organized by universities and are always optional. They also noted that in most cases they are more of paper presentations rather than training sessions. The study, therefore, noted that lecture method that was being used was inadequate to train students in using statistics in research.

4.3 Influence of Curriculum Implementation on use of Statistics in Research

The study sought to determine the influence of curriculum implementation on use of statistics in research. A regression analysis was carried out and the output value tested against the set alpha level of 0.05. Predictor variables were categorized in two models, model one and model two. Model one was about if the concepts were taught or not and model two comprised of both if concepts were taught or not and if they were well practiced in class using samples of data. The study found out that teaching or failure to teach required statistical concepts accounted for 27.6% of finding it easy or difficult to use statistics in research. This is as indicated by the R square value of 0.276 against model 1. When teaching of the concepts is combined with practice using samples of data it accounts for 68% of using statistics in research. This is as indicated by the R square value of 0.680 against model 2. The results are as shown in table 1.1 below.

Table 1.1: Regression Model Summary of Curriculum Implementation.

Model	R	R Square
1 (Concepts were taught in class)	.526[a]	.276
2 (Concepts were taught in class and practiced)	.824[b]	.680

The findings indicate that a student who was taught all the required statistical concepts and used samples of data during the learning process is 68% more likely to find use of statistics in research easy. Model one explains 27.6% of the dependant variable and model one and two combined explains 68.0% of the dependant variable. The study sought to determine if this influence was statistically significant. An analysis of variance was carried out. The Sig. value for model 1 and were 0.001 and 0.000 respectively. Both were below the testing alpha level of 0.05 meaning that teaching statistical concepts and practicing the same concepts with sets of data is statistically significant in explaining use of statistics in research. The results are as shown in table 1.2 below.

Table 1.2: ANOVA Summary of Curriculum Implementation Process.

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	16.058	6	2.676	4.392	.001[b]
	Residual	42.048	69	.609		
	Total	58.105	75			
2	Regression	39.485	14	2.820	9.240	.000[c]
	Residual	18.620	61	.305		
	Total	58.105	75			

The study findings imply that when the curriculum is well implemented the students will be better placed to use statistics in research. However, this analysis is inclusive of all variables under study in relation to curriculum implementation. It is worth noting that some of the variables contribution was not statistically significant and could have just occurred by chance. To eliminate the aspect of occurrences by chance being included in regression analysis the study employed an automated stepwise exclusion of these variables.

After a stepwise linear regression analysis four variables were found to be the ones that were statistically significant in explaining the dependant variable. The four variables were; Integrating of statistics and ICT concepts; Being taught how to determine the statistic to use when analyzing data, Being taught how to use computer software to do statistical analysis; and learning and practicing inferential analysis. The first model of the analysis was made up the first variable above and the subsequent models had one additional variable based on the order of the variables above. The R square value for model 1, 2, 3 and 4 was 0.264, 0.360, 0.399 and 0.443 respectively. Significant F change for model 1, 2, 3 and 4 was 0.000, 0.001, 0.032 and 0.022 respectively. This meant that all the four variables were significant in explaining the use of statistics. In addition the analysis determined that curriculum implementation accounts for 44.3% of use of statistics among postgraduate students. The results are as shown in table 1.3 below

Table 1.3: Summary of Significant Variables of Curriculum Implementation.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.514[a]	.264	.254	.76025	.264	26.531	1	74	.000
2	.600[b]	.360	.342	.71396	.096	10.906	1	73	.001
3	.632[c]	.399	.374	.69616	.040	4.781	1	72	.032
4	.665[d]	.443	.411	.67526	.043	5.527	1	71	.022

The study findings lead to rejecting the null hypotheses that *Statistical syllabus implementation process has no significant influence on student's use of statistics in research*. These meant that students who were adequately trained in use of statistics were 44.3% more likely to use statistics

easily. On the other hand students who were not adequately trained in use of statistics were 44.3% less likely to use statistics with ease in research. The study noted that curriculum implementation for statistics training among masters' students in sampled universities was inadequate and this was affecting students' use of statistics negatively.

This finding concurs with Clark (1993), who noted that institutions of higher education were operating under mandates systematically at odds with interests of science. He argued that students training of non science professionals, academic staff is steered by expectations and duties that have little to do with pursuit of research or the training of future researchers. The findings limit the possibility of sampled universities being research universities unless the curriculum implementation is fixed. This is based on the argument by Muia and Oringo (2016) who noted that training is an important aspect of research productivity in universities. Sawyerr (2004) also notes that, the capacity of individual researchers, including their skills, competencies, attitudes, and values, is developed primarily through appropriate training programs. This training program was determined by the study to be inadequate in sampled universities.

5. CONCLUSION AND RECOMMENDATION

The study sought to determine how the curriculum is implemented in relation to use of statistics in research. The study also was to determine how the implementation was influencing use of statistics in research. The study determined that majority of the sampled respondents were taught how to determine the statistic to use, how to interpret figures and tables and descriptive statistics. The study determined that less than half of the sampled students were taught inferential statistics and less than a third were taught basic computer skills and how to use statistical computer software. Not all who were taught these concepts practiced them in class using sets of data. The study established that 30.3% of the sampled respondents were in classes where ICT and statistics concepts were well integrated. The other classes were either not taught ICT or it was taught in separation with statistical concepts. The study established that students who were adequately trained in use of statistics were significantly more likely to use statistics easily in their research.

The curriculum implementation process was flawed in majority of the classes and did not meet the needs to use statistics in research. The flaws were attributed to various issues including; First the courses were too wide and therefore a thorough implementation meant that the course could not be finished on time; Secondly the curriculum did not adequately integrate ICT and specifically use of statistical software; Third is the inadequate technological resources; Fourth are the poor instructional methodologies used; And lastly is the inadequate assessment tools that could not encourage thorough training. The tools of assessment were also not able to bring out the inadequacies in the training process.

The study, therefore, stands by the recommendations made in other subsections of this chapter in relation to; increase of training courses, appropriate integration of ICT and statistics, availing of resources and improving assessment techniques. In addition to this the study recommends that instructional methodologies should be enriched to enhance training. Training institutions and universities should adopt use of workshops and attachment in addition to lecture method, tutorials and class presentations by students. Masters' students should attend at least three workshops

concerning use of statistics in research organized by the training institution. This should be compulsory and should count towards graduation of the student. It should also be compulsory that a student is attached to a research project or firm that is actively involved in use of statistics in research. The attachment should be for a period of not less than three months and it should count towards the graduation of the student.

REFERENCES

Assimakopoulos, D., & Yan, J. (2006). Sources of knowledge acquisition for Chinese software engineers. *R&D Management*, *36*(1), 97-106.

Belli, G. (2001). The teaching/learning process in university statistical consulting labs in the United States. *Training researchers in the use of statistics*, 325-338.

Bishop, G. & Talbot, M. (2001). Statistical thinking for novice researchers in the biological sciences. *Training researchers in the use of statistics*, 215-226.

Clark R. B. (1993) *The research Foundations of Graduate Education. Germany, Britain, France, United States, Japan.* University of Caifornia press, Los Angeles.

Cloete, N., & Maassen, P. (2015). Roles of universities and the African context. *Knowledge production and contradictory functions in African higher education*, 1-17.

Crivisqui, E., Abruzzini, S., & Batista, C. M. (2001). How to Overcome the Gap between the Available Statistical Methods and their Effective Use By Researchers in Social Sciences. A few Thoughts about the Experience in the Presta Programme. *Training Researchers*, 277.

Estabrooks, C. A., Rutakumwa, W., O'Leary, K. A., Profetto-McGrath, J., Milner, M., Levers, M. J., & Scott-Findlay, S. (2005). Sources of practice knowledge among nurses. *Qualitative health research*, *15*(4), 460-476.

Fletcher, M., & Harris, S. (2012). Knowledge acquisition for the internationalization of the smaller firm: Content and sources. *International Business Review*, *21*(4), 631-647.

Glencross, M. J., & Binyavanga, K. W. (1997). 25. The role of technology in statistics education: a view from a developing region. *Research on the role of technology in teaching and learning statistics*, 301.

Harraway, J. Manly, B. Sutherland, H. & McRae, A. (2001). Meeting the statistical needs of researchers in the biological and health sciences. *Training researchers in the use of statistics*, 177-195.

Mji, A., & Glencross, M. J. (2001). The role of a research resource centre in the training of social science researchers. *South African Journal of Higher Education*, *15*(2), 179-185.

Mubichakani M. J. (2019) The Influence of Personal Factors on Masters' Students' use of Statistics in Research in *International Journal of Research and Analytical Reviews (IJRAR) www.ijrar.org* 409 - 417

Muia, M. A. and Oringo, O. J. (2016) Constraints on Research Productivity in Kenyan Universities: Case Study of University of Nairobi, Kenya in *International Journal of Recent Advances in Multidisciplinary Research* Vol. 03, Issue 08, pp.1785-1794,

Mukhwana, E. Oure, S. Too J. and Some D. K. (2016): *State of Postgraduate Research Training in Kenya. Commission for University Education.* Discussion Paper 02. Nairobi, Kenya.

Musiige, G., & Maassen, P. (2015). Faculty perceptions of the factors that influence research productivity at Makerere University. *Knowledge production and contradictory functions in African higher education*, 109-127.

Rossman, A. J. (1997). Workshop Statistics: Using Technology to Promote Learning by Self-Discovery. *Research on the Role of Technology in Teaching and Learning Statistics*, 221.

Sabzwari, S. Samreen, K. and Khuwaja, A. K. (2009) Experiences, attitudes and barriers towards research amongst junior faculty of Pakistani medical universities in *journal of BMC Medical Education.*

Saville, D. J. (2001). A hands-on, interactive method of teaching statistics to agricultural researchers. In *In C. Batanero (Ed.), Training researchers in the use of statistics (pp. 197-213). Granada: International Association for Statistical Education and International Statistical Institute*.

Sawyerr, A. (2004) African Universities and the Challenge of Research Capacity Development in *JHEA/RESA* Vol. 2, No. 1, pp. 211–240

Scott (2015) *Why Kenya ranks low on quality of academic research,* retrieved from *https://www.businessdailyafrica.com/lifestyle/society*

Sprent, P. (2003). Statistics in medical research. *Swiss medical weekly*, *133*(3940).

Svensson, E. (2001). Important considerations for optimal communication between statisticians and medical researchers in consulting, teaching and collaborative research–with a focus on the analysis of ordered categorical data. *Training researchers in the use of statistics*, 23-35.

Tijssen, R. (2015). Research output and international research cooperation in African flagship universities. *Knowledge production and contradictory functions in African higher education*, 61-74.

Votruba, C. J (1996) Strengthening the University's Alignment with Society: challenges and Strategies in *Journal of Public Service and Outreach*, Volume 1, pp 29-36

Wei, Y. (2001). The training of researchers in the use of statistics in China. *Training researchers in the use of statistics*, 311-317.

Yamamoto, S. (2001). *Basic research and the role of universities in Japan:* Workshop on basic research at Oslo, Norway, 29-30 October 2001. Retrieved from http://www.oecd.org/dataoecd/39/32/2674535.pdf

Yin, R. K (2003) Case study Research Design and Methods, Sage publication limited, London.

Zwiers, F. W., & Von Storch, H. (2004). On the role of statistics in climate research. *International Journal of Climatology*, *24*(6), 665-680.