The Influence of Technological Resources on Masters' Students' Use of Statistics in Research

*Mubichakani M. Joseph, Simiyu John and Kitainge M. Kisilu
Science Education Department University of Eldoret
***Corresponding author's Email:** joemukuyuni@gmail.com

ABSTRACT

Knowledge is vital for development in any sector of the society. For instance, knowledge is attributed with successful innovation in firms. Research has been identified as the main source of knowledge. University students in Kenya have been perceived to be carrying out low quality research. Statistics in research in meant to facilitate communication of findings and support hypotheses, credibility of methodology and conclusion in a given study. Studies have pointed to wrong use of statistics as a contributing factor towards low quality research. The study was; to determine how technological resources influence masters' students' use of statistics in research, a case of universities in western Kenya. The study was based on normative paradigm and interpretive philosophy. The study used descriptive survey design complimented with case study design. A total of 83 respondents sampled from three different universities in western Kenya participated in the study. Frequencies and regression analysis were used to analyze data. The study found out that 68.4% of the masters' students struggled to use statistics in research. Resources in universities that participated in the study were scarce. The study determined that the scarcity was negatively affecting use of statistics in research. The study, therefore, noted that if at all the affected universities wish to be in the league of research universities, they have no otherwise but to equip themselves with resources.

Keywords: Technological Resources, Statistics, Research

INTRODUCTION

Knowledge is an important aspect in any given society. Yamamoto (2001) noted that Knowledge is an important asset for development and prosperity in all aspects of human understanding. Given this importance of knowledge, it is prudent that sources of knowledge are identified and protected. Review of documented literature identifies research as a key source of knowledge (Yamamoto (2001); Estabrooks, Rutakumwa, O'Leary, Profetto, Milner (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, Oure, Too & Some (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) attribute 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; enable generation of data that gives answers to research questions; and lead to reliable conclusions based on collected and analyzed 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 the limited training of researchers in use of statistics in research (Harraway, Manly, Sutherland & McRae 2001). The causes of low quality research in Kenya remain unclear but can be hypothesized to be caused by ineffectiveness in use of statistics as it has been found out in other continents.

The guiding objective of the study was; to determine the role of technological resources on masters' students' application of statistics in research, a case of universities of western Kenya. The purpose of this paper was with an intention of suggesting necessary measures to be incorporated into masters' students' use of statistics. In order to accomplish its main purpose, the study was broken down into specific objectives that were to be achieved by the end of the study. The study sought to determine masters' students' use of statistics, the availability of technological resources and the influence of the availability of resources on use of statistics.

LITERATURE REVIEW

Statistics Component of Research

Research, sometimes referred to as scientific inquiry, is an extensive discipline that comprises several components. Bishop and Talbot (2001) note that accepted ways to determining answers to research questions is observation, use of laws, use of theories, experimentation and inference. In this five categories, Bishop and Talbot (2001) argue that statistical concepts are important in observation, experimentation and inference. They note that statistics enables one to; analyze and interpret data, generated data is important in giving findings of research questions; and statistics provides a basis for reliable conclusions based on collected data. Sprent (2003) notes that statistics in medical research starts at establishing the design and size of an experiment. He noted that statistics is important at the stage of analysis of sample data to make conclusions in relation to the entire population. Zwiers and Von Storch (2004) noted the importance of statistics in specifically climate research. They said that statistical analysis helps to quantify the effects of uncertainty in climate research, both in terms of observation and measurement and in terms of our understanding of the processes, which govern climate variability. Generally, they concluded that study of climatic system is more of the study of statistics of patterns of weather.

Given the discussed important role of statistics in carrying out research the study sought to determine from literature the influence of adequacy or inadequacy of statistical knowledge to the quality of research carried out. Most of the information in this aspect was mainly from Asia, Europe and United States. Murray (1991) noted that several reports in the medical literature were flawed because of poor presentation of numerical results, or, more seriously, by the use of inadequate or inappropriate statistical methodology. Maindonald (1999) points

out that when he reads published papers, he is persuaded that there is a serious problem with research design, data collection procedures and the resultant data analysis. Svensson (2001) came up with findings that agree with Murray and Maindonald. He noted that his analysis of medical journals had revealed poor quality methods and statistics that were being used. He further argues that the increasing use of complex methods was making the situation even worse.

Bishop and Talbot (2001) noted that postgraduate students from non-statistical disciplines often present low quality research because they have trouble developing an appropriate design for their study. This case they found to be worse if the student's supervisor also lacks the statistical knowledge or is not from a statistics discipline. Bishop and Talbot (2001) noted that in such a case relying on research consultant cannot rescue a study that already has a poor design. Sprent (2003) records that despite the wide use of statistics in research; simple concepts are on some occasions not well understood or not well interpreted by researchers in non-statistical courses. This he noted that it leads to papers, or research findings, that give inadequate statistical analyses or present inappropriate results and the worst is they can present wrong results. As stated earlier, this studies were carried out in Asia, Europe and America, little is known about if the same issue of statistics affects the quality of African research, and particularly in Kenya.

The study sought to find out more on why some researchers either misunderstand or fail to understand how to use statistics which leads to the poor quality research discussed above. The first reason that was determined is the aspect of research being carried by non-statisticians. Glencross and Binyavanga (1997) in their contribution on this matter noted that it is because in modern world, much work involving data collection and data analysis is being conducted by non-statisticians. They further stated that many of this researchers, without statistical background, have little understanding of appropriate methods of data collection and have little comprehension of the assumptions underlying the statistical methods of analysis they use in their research work. The authors also noted that such researchers are not capable of providing sensible interpretations of the results in their research. It may be argued that research should then be left to statisticians alone. This will however raise other incompetence issues now not in statistics but in the core discipline that research is being carried.

Saville (2001) proposes a more sensible solution that there should be continual communication between statisticians and researchers in various fields. This however is not an authorization for non-statistician researchers to avoid having information on statistics all together. Saville (2001) the proponent of this proposal recommends that, best results are obtained when the researcher has appropriate knowledge of statistical methods in use in the research, and the statistician has appropriate overall knowledge of the research purpose and objectives. This argument is also shared by Bangdiwala (2001). The coming up of statistical software has, however, reduced the over reliance on statistician consultants, except in unique and complex cases that cannot be solved by the software. Svensson (2001) however, warns that depending on statistical software with little or no statistical knowledge could lead to inappropriate use in interpretation of statistics. This, therefore, means training of researchers in how to use statistics is not optional. Once trained, it will be a solution to poor quality research resulting from ignorance in statistics. This leads us to the second reason of poor quality research, which is inadequate training in statistics.

Harraway et al. (2001) point out that problem for researchers especially with research students is often the inadequate training in research design and methodology. Harraway et al. (2001) identified both as being essential for planning and analyzing research data. The authors go ahead to point out the benefits of proper training. He states that, training in use of statistics in research enable researchers to carry out quality research due to benefits from proper understanding and use of statistical methods. On the other hand, Iversen (2001) has a different opinion on what training in statistics for researchers should be all about. He argues that the purpose of teaching statistics in non-statistical courses is to enable students to carry out empirical research themselves. Researchers agree that statistics training is important to a researcher. While other continents across the world have documented information on training and use of statistics in research, Africa is lagging behind on this aspect.

It can, therefore be hypothesized based on reviewed literature that use of statistics is contributing towards the minimal and poor quality research being carried out in Africa and specifically in Kenya. This study therefore sought to determine the influence of technological resources on use of statistics.

Technological Resources and use of Statistics in Research

Information and Communication Technology is increasingly being used in several sectors in the contemporary world. ICT once adopted into a sector has its own benefits and such sectors have to adjust to work hand in hand with ICT. Generally, Jung (2005) indicates that Information Communication Technology (ICT) has the ability to change the way teachers teach. ICT is useful in supporting student-centered approaches of instruction and is key in developing the higher order skills. These sentiments were also affirmed by Mubichakani (2012) who established that computer-based learning process is more fun, stimulating and satisfying as compared to traditional methods which were non-technological. Mubichakani and Koros (2014) also noted that computer-based learning ensured every student is subjected to same treatment, that is, same encouragement, same motivation and same chances in the process of learning regardless of the gender. A positive to be pointed out is that at primary and secondary education level, ICT is likely to be embraced based on the findings by Rotich, Ronoh & Mubichakani (2018) that primary school teachers have positive attitude towards computers.

Specifically, ICT has made its way into statistics and especially how it is applied during research. Jones (1997) argues that manual calculation of a correlation coefficient is involving, takes a lot of time, and one is likely to have calculation errors. However, he notes that statistical packages have been developed which make the calculation quick and accurate. Friedman (2001) points out the computer revolution that has completely altered data collection and analysis. He notes that much of data in recent times is automatically recorded with computers. The result of which has been the collection and analysis of very large data in terms of both the number of observations, and the number of measurements recorded. Ashley (2018) gives a good summary of the quantitative data analysis computer software available. They are as follows; Statistical Package for Social Sciences (SPSS); STATA, the name STATA is an abbreviation for the word statistics and data; and Statistical Analysis System (SAS)

This introduction of statistical software has changed the way statistics is being trained in universities. Starkings (1997) points out that calculators and computers should be recognized as important tools in carrying out of statistics. He notes that teaching methods

and syllabuses should take into account these important tools. Sawyerr (2004) indicates that research training should be rich in technological resources in addition to rich methodologies. This changes and call for changes were noted to have taken root in some universities, especially research universities. Wei (2001) found out that computer-aided teaching was common, as a result of being advocated for, in most training institutions including universities in China. Most of the training institutions were having a course for SAS.

Mji and Glencross (2001) noted that in South Africa, University of Transkei had set up resource centre fully furnished with research resources. Among the aims of the resource centre was to provide access to computers and statistical software for training and use in research. However, not all Universities may have a privilege of having these resources. Wei (2001) indicates that China had not been able to meet higher education needs; he attributed this to the fact that China was a developing country. This can also be hypothesized to be the case for Kenyan universities, a hypothesis that this study sought to test.

METHODOLOGY

The study was based on positivism philosophy and interpretivism philosophy. The two philosophies were important since they differ in various aspects including their views on the nature of knowledge and reality. The philosophies, however, complement each other on their points of weaknesses and it is based on this that the study employed both of them. The study adopted a descriptive survey design and a case study design. The purpose of having two designs was to meet the needs of the two different philosophies employed by the study. Two public universities and one private university in western region of Kenya participated in the study. The study target population was masters' students who had submitted their project reports for examination. A sample of 90 masters' students participated in the study. The sample was arrived at using stratified and simple random sampling techniques. Purposive sampling was key in sampling four masters' students and three lecturers of research methods who were interviewed by the researcher and research assistants to investigate the reasons behind use or failure to use statistics in research among masters' students.

Data collection tools for the study involved questionnaire and in-depth interview schedules. The first set of data to be collected was by use of questionnaire. Thereafter the researcher interviewed four masters' students for in-depth information and possible explanation of quantitative data collected using questionnaire. Lastly, the research methods lecturers were interviewed. Collected data was analyzed using descriptive frequencies and multiple linear regression.

RESULTS AND DISCUSSION

Masters' Students Use of Statistics in Research

Statistics is an important aspect of research; Bishop and Talbot (2001), states that it is important in observation, experimentation and inference; Sprent (2003) and Zwiers and Von Storch (2004) follow suit to agree that statistics is important in research. Given this importance the study sought to determine how masters' students found the process of using statistics in their research. The study determined that 31.6% of the students felt that the use of statistics in research was easy, while 68.4% indicated that the process was difficult. The detailed findings are as indicated in Figure 1.

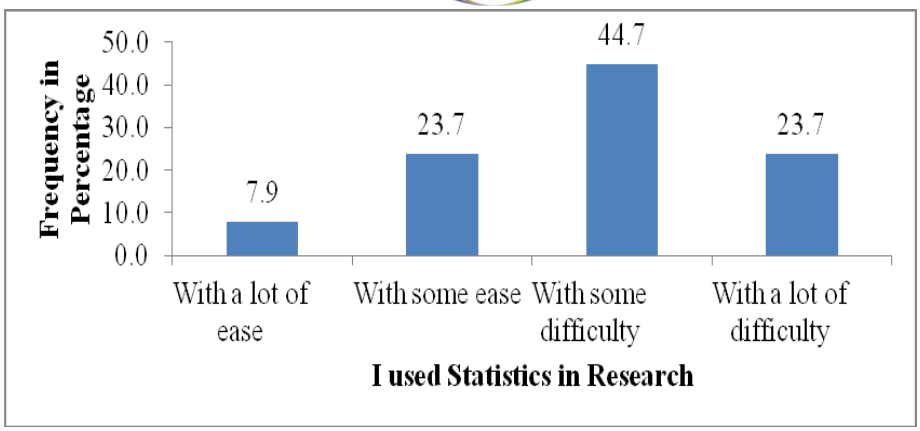

Figure 1: Students use of Statistics in Research

Generally, 68.4% of the sampled masters' students found it difficult to use statistics in research. This finding compliments the finding by Murray (1991) who was interested in finding if the statistics is appropriately used in research. He noted that the use of statistics was flawed, inadequately or inappropriately used. Sprent (2003) had also recorded a similar case where he noted that simple concepts are sometimes not well understood by researchers in non-statistical disciplines. Collectively, this study and the study by Murray and Sprent confirm Maindonald (1999) suspicion of there being a problem with research design, data collection and analysis. His suspicion came about after realizing the poor quality papers that were being published by some researchers. The study findings explain the findings by Bishop and Talbot (2001) who noted that postgraduate students from non-statistical disciplines often present low quality research.

This finding adds to Scott (2015) who notes that there is low academic research excellence in Kenya. The author further notes that there is a mismatch between masters' students' mastery and use of content in their area of specialization and mastery and use of statistics in research. These findings explain the unwillingness and inability to conduct research among postgraduate students especially PhD students as noted by Mukhwana et al. (2016). The poor quality research and inadequate statistical used in published research is explained in this study by the large number of masters' students that have been found to be struggling to use statistics in research. This should be noted that the struggle is after the training about use of research in statistics.

Availability of Technological Resources

The study sought to determine if sampled universities had computers and statistical software. Based on data collected by questionnaire, 72% of the respondents noted that their universities did not have enough computers and statistical software, 16% noted that their universities had enough technological resources and 12% were not aware if the resources were adequate or not. The study established during interview sessions that sampled universities had postgraduate computer labs or section set aside for post graduate students but these labs had very few computers in relation to the postgraduate students enrolled. In some cases, the set aside sections were just for postgraduate students to find a sitting space but with no computers at all.

The study also sought to determine if individual students had access to their own technological resources. The analysis showed that 84.2% of the sampled respondents had easy access to a computer, 42.1% easily accessed computer software for data analysis and 73.7% had easy access to source of power. The findings are as indicated in Figure 2.

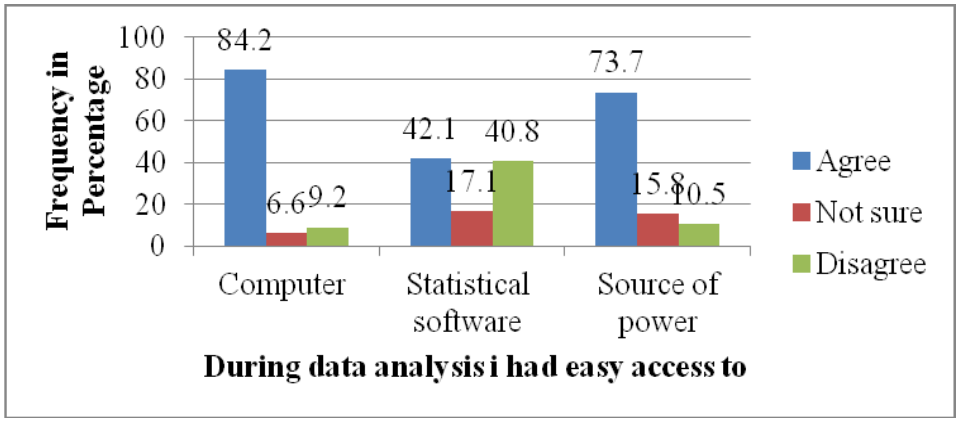

Figure 2: Access to Personal Technological Resources

The findings indicate that majority of the sampled universities did not have adequate technological resources. Majority of individual students, however, were noted to have easy access to computers but less than half could access statistical software. These findings are similar to Muia and Oringo (2016) finding that University of Nairobi had inadequate materials and equipment for research. This is also the case in other countries. Wei (2001) indicates that in China ICT facilities in most training institutions were lagging behind.

These findings indicate that the situation has not changed despite Mukwhana et al. (2016) sentiments that universities were striving to provide support infrastructure to graduate students. They noted that the support included research laboratories and computers. A comparison of the finding to research universities shows a completely different picture. Research universities have invested in acquisition of technological resources for research. Mji and Glencross (2001) noted that the University of Transkei in South Africa had established a resource centre equipped with research resources. The study, therefore, noted that inadequacy of technological resources in sampled universities is a factor of concern. However, the impact of inadequacy of resources is slightly lowered by the fact that students were accessing their own resources.

Influence of Technological Resources on use of Statistics in Research

The study sought to determine how the availability of technological resources was influencing the use of statistics in research. A regression analysis was carried out and the findings were as follows; Access to computers whether privately or in institution explains 17.6% of use of statistics, this as indicated by R square value of 0.176 against model 1; Access to computer and statistical software explains 40.5%; and access to computer, statistical software and source of power explains 44.6%. The percentages are determined by the R square value of 0.176 against each model. The results of the analysis are as shown in Table 1.

Table 1: Regression Model Summary of Technological Resources.

Model	R	R Square
1 (Easy access to computers)	.420[a]	.176
2 (Easy access to computers and statistical software)	.637[b]	.405
3 (Easy access to computers, statistical software and source of power)	.668[c]	.446

The findings in Table 1 indicate that a student who has access to technological resources being discussed is 44.6% more likely to use statistics. It was important to determine if the percentages presented above that technological resources explain use of statistics was just by chance or are percentages that were statistically significant. An analysis of variance was carried out and resulting significant figures tested at alpha level of 0.05. The study determined that the significant values for all the three models were 0.000. This means that the influence of adequacy of technological resources was statistically significant. The results are as indicated in Table 2.

Table 2: ANOVA Summary of Technological Resources

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	10.230	1	10.230	15.813	.000[b]
	Residual	47.875	74	.647		
	Total	58.105	75			
2	Regression	23.554	2	11.777	24.883	.000[c]
	Residual	34.551	73	.473		
	Total	58.105	75			
3	Regression	25.899	3	8.633	19.299	.000[d]
	Residual	32.207	72	.447		
	Total	58.105	75			

In order to determine the most significant variables of the three, access to computers, access to software and access to source of power, a stepwise multiple linear regression was applied to the set of data. The outcome indicated that access to statistical software and access to power source explained the use of statistics more than just accessing computer alone. Model 1 was access to statistical software and Model 2 was access to statistical software and source of power. The analysis determined that R square for model 2 was 0.442 meaning that technological resources in question explain 44.2% of use of statistics. Significant values for model 1 and 2 were 0.000 and 0.001 respectively both being lower than 0.05. This means that technological resources are statistically significant in explaining use of statistics. Summary of the results are as shown in Table 3.

Table 3: Summary of Significant Technological Resources

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	.592[a]	.351	.342	.71386	.351	40.024	1	74	.000
2	.665[b]	.442	.427	.66628	.091	11.946	1	73	.001

The study finding leads to rejecting the hypotheses that *Technological resources have no significant influence on student's use of statistics in research.* In other terms having access

to computers, statistical software and source of power greatly improves the chances of a student finding the process of use of statistics easy. This meant that if universities could improve on availing resources especially computers and computer software for data analysis, it will greatly improve the likelihood of their students' finding it easy to use statistics in research.

The study findings agree with sentiments by Sawyerr (2004) who noted that research training should be rich in resources. The findings indicated that sampled universities are not taking into consideration Starkings (1997) point that calculators and computers must be recognized and used as important tools in statistics. This ignoring of availing technological resources was determined by the study to be a stumbling block to use of statistics among masters' students. It would be expected that given the importance of resources in using statistics universities should embrace equipping laboratories with resources. Clark (1993) identified that one of the key challenges universities are facing in relation to equipping laboratories with resources is the transition from elite to mass higher education. He noted that this has led universities to extended first degree instruction approaches that are often not closely linked with research and are theoretical to postgraduate levels. This is also coupled up with limited funding at postgraduate level in favor of basic education as noted by Sawyerr (2004). Despite the stated reasons, the study determined that inadequate resources are negatively impacting the use of statistics in research.

CONCLUSION AND RECOMMENDATIONS

The study sought to determine the availability of technological resources in universities and at individual level and how the availability influenced use of statistics in research. The study determined that majority of the sampled universities did not have adequate computers and statistical software. The study found out that majority of the sampled respondents had easy access a computer and source of power but less than half easily accessed computer software for data analysis. The study determined that access to computers, statistical software and source of power significantly improves the chances of a student finding the process of use of statistics easy.

Universities had very few computers and statistical software and this was a major setback to facilitating students' use of statistics in research. Despite students accessing personal computers, it is of little use if they do not have an opportunity to practice what has been learned together with their lecturers. Hands-on training on use of statistics cannot be possible without computers and computer software being availed by institution. Use of workshops and practical as instruction approaches are effective in training, however, they cannot be used with limited resources. The study noted that the inadequacy of resources hampered curriculum implementation which in turn negatively affected use of statistics in research.

If sampled universities and others with inadequate resources wish to be in the league of research universities, they have no otherwise but to invest in resources. Training institutions should establish postgraduate research centers. The centers should be well equipped with adequate computers, statistical software and internet connection. This will facilitate use of practical, workshops and working on examinations by the students.

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