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The Effect of Instruction with SPSS on Students' Achievement and Attitude towards Hypothesis Testing: A Case of Zambia Catholic University

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Abstract: ***The study was conducted to explore the effect of instruction with SPSS on Student's achievement and attitude towards hypothesis testing at Zambia Catholic University. The design of the study was a randomized pre-test post-test control group experimental research design. Second year students enrolled in 2017 doing STAT210(a statistics course offered to second year students) formed the population of this study. The sample was divided into two groups of the same size (i.e. the experimental (24) and control (24)). Before the treatment the two groups were exposed to a pre-test to establish the equivalence and homogeneity of the two groups whereas the post-test was used to assess the effect of the intervention on students' achievement and attitude towards hypothesis testing. Data were analyzed with independent samples t-test statistics on hypothesis testing pre-test(HTPreT) and hypothesis testing post-test(HTPT) scores for control and experimental groups. After the intervention, it was found that there was a statistically significant difference in achievement in hypothesis testing post-test (HTPT) in favor of the experimental group. The gender differences were not seen to affect performance of students in hypothesis testing after learning in SPSS environment. Moreover, the study found that experimental students' attitude towards learning statistics through technology improved, as well.The researcher concluded that SPSS may be an effective tool for teaching hypothesis testing to students at Colleges and Universities asit was found that the use of SPSShad a positive impact on students' performance in hypothesis testing.***

Keywords: SPSS, achievement, attitude, Hypothesis testing, technology

1. Introduction

The teaching and learning of statistics has pervaded all levels of Education and has gained recognition in many disciplines over the past two decades (Gillian, 2012)Statistics continues to be an integral part of the post-secondary curriculum. In almost every discipline the ability to understand, interpret and critically evaluate research findings is becoming essential core skill (Gillian, 2012). College and University students interested in becoming practitioners need to be able to analyze and interpret statistical data. Statistics courses are a valuable component to many, if not most courses of study (Jatnika, 2016). The value of statistics knowledge continues well beyond the educational period, as most professions benefit from some level of statistical understanding.

Despite the value placed on statistics by the instructors of higher education, few students eagerly anticipate taking a course in statistics because they feel that statistics is more difficulty than other subjects (Stork, 2003). In fact, students often find statistics tedious and difficult and approach it with a level of fear in most higher learning institutions and Zambia Catholic University is not an exception. For instance, in 2016 academic year examination, STAT 210 (Statistics course) had the lowest pass percentage of 46%. Analyzing the performance on each topic of the course reviewed that only 31%of the students attempted the questions on hypothesis testing and only 19% of them got the questionscorrect. Jatnika (2016) stated that Student in Faculty of Psychology think that Statistics is very difficult for them, because Statistics is viewed as a hard science than Psychology which is viewed as a soft science and so teachers of statistics have to work had to improve their instructions .It is because of these reasons that teachers of statistics are constantly looking for new ways to improve their teaching and help students understand statistics.It is therefore argued that the poor performance could be attributed to pedagogical approaches used to teach statistics. There is a need to consider remedial approaches of teaching quite different from the routine ones. The use of SPSS is one such a remedial approach that enhances the students' active role in the lessons (Hubbard, 2002).

Instructions with SPSS approach involves teaching statistics topics through the use of a computer and SPSS software by helping learners carry out different statistical analysis. Students gain a deeper understanding of statistical ideas and processes by engaging them in doing statistics such as coming up with the graphs, conjecturing as well as exploring statistical ideas (Gomez, 2014). It is against this background that this study investigates the effect of instruction with SPSS software on students' achievement and attitude towards hypothesis testing.

1.1 Statement of the Problem

Often, students think that statistics are too difficult to learn or just not worth putting the effort in to master them (Petrocz, 2012). Jatnika (2016) also states that students' personal experiences toward statistics are often a source of anxiety producing negative perceptions.Many researchers have indicated that courses in statistics are among those that cause the most anxiety, especially for students in non-mathematics oriented disciplines (Reid, 2001). Hypothesis testing is one of the topics that are taught to Second year

students in statistics at Zambia Catholic University and other higher institutions in Zambia. It is one of the topics in statistics which many students find difficulty to understand(Hubbard, 2002). It seems to be generally agreed by statistics facilitators that our students do not perform well in this concept of hypothesis testing and Zambia Catholic University is not an exception. In the 2016 academic year examination at Zambia Catholic University, SAT 210 (Statistics course offered in second year) had the lowest pass percentage of 46%. A further analysis by topic tends to suggest that students' poor grasp of the concept of hypothesis testing was one of the contributing factors to the poor performance in statistics. For instance, it was revealed that 31% of the students attempted the questions on hypothesis testing and only 19% of them got the questions correct.

According to the results analysis report for STAT 210 in 2015 at Zambia Catholic University, only 58 out of 76 students got above 50% in the promotion examination. The report also revealed poor performance of students in 2016 when compared to other courses where 20% of the students had their scores below 40% in the same course. In 2017 out of 46 students who sat for STAT210 examination 17 students got below average. The mean performance for the years 2015 and 2016 were 54% and 46% respectively, while in 2017 the mean performance was 49%. This indicates that students who obtained below 50% did not master the concepts and skills tested.This recurring poor performance of learners in this topic calls for concerted efforts by statistics facilitators in institutions of learning to adopt teaching and learning approaches that will help to improve learners' performance. This persistence in poor performance of learners may mean that the real source and solution to the problem has not been systematically established. It was therefore the aim of this study to investigate whether instruction with SPSS approach will be an appropriate alternative to teaching Hypothesis testing so as to enhance students' performance.

1.2 Objectives of the Study

This research was guided by the following research objectives:
Main objective: To find out the effect of the instruction with SPSS software on student's achievement and attitude towards hypothesis testing**.**

Specific objectives:
1) To determine whether the use of SPSS has an effect on student's achievement in hypothesis testing.
2) To compare the achievement of male and female students in hypothesis testing taught using SPSS.
3) To examine the effect of using SPSS on students' attitude towards hypothesis testing.

The above objectives translated into the following research questions:
1) What is the effect of using SPSS on students' achievement in hypothesis testing?
2) Is there any significant difference between the achievement of male and female students in hypothesis testing taught using SPSS?
3) What is the effect of using SPSS on students' attitude towards learning hypothesis testing?

2. Literature Review

SPSS introduced the first mainframe statistical software package to appear on a personal computer (Prvan eta al, 2002). **SPSS** recently received the 2002 Illinois High Tech Award for statistical software innovation. According to Prvan et al., (2002), **SPSS** will carry out almost all statistical analyses required at a professional level, and certainly covers all that would be needed in a first statistics course. Ryan, (2004) States that students learn statistics only if they actually practice statistics through a whole range of statistical activity supported by an appropriate computer package such as **SPSS.**

Critics of using technology in teaching statistics argue that students have to spend time learning the package and are therefore not concentrating on learning statistics (Gillian, 2012).Some researchers although argue that using a statistical package such as SPSS can overcome some of the difficulties faced by the students in understanding of statistical concepts.There are few research studies indicating that SPSS enhance student's academic achievement. Some of these studies are mentioned in this section.Most researchers tended to come up with the similar conclusion that the use of statistical packages in the teaching and learning of statistics enhances the teaching and the understanding of the subject by many pupils or students. For example, Jatnika (2016) argued in her paper, that students who used SPSS in learning statistics felt that their knowledge and skills increased significantly when applying statistics.According to Larwin (2011) traditional methods of teaching introductory statistics are generally viewed as being ineffective because they fail to establish a clear link between statistics and its uses in the real world. He added that to be more effective, using computers with software programs in the introductory statistics course would be one of the important ways to improve student knowledge about statistics and its usefulness in real life. Furthermore, Chance etal (2007) states that the opportunity to use computers in teaching statistics provides hands on activities, supports cooperative learning, provides active learning, constructive learning experiences and produces greater peer interaction. Moreover, Millar (2012) adds that one-hour laboratory using SPSS provides opportunities for students to engage with statistical concepts within a learning environment supported through problem-based learning and exchange of ideas.

Gomez (2002) carried out a study that evaluated the use of SPSS on students' achievement and attitude in probability and statistics course for senior level students. Two sections of the class were compared with respect to the use/non-use of SPSS in the course; the experimental group (the one that used SPSS) outperformed the control group on five out of six teacher created unit tests. Additionally, the experimental group expressed positive attitude towards the use of the software in a survey administered at the conclusion of the course. Morris (2013) conducted a study to evaluate the impact of using SPSS software when teaching inferential statistics. The study used the quasi-experimental research design as it divided the study sample randomly into two

groups: one is experimental whose students studied using SPSS software while the other is control whose students studied inferential statistics using the traditional method. An achievement test was administered to both groups after teaching together with an attitude scale. The results showed the excelling of the experimental group over the control group which studied using the traditional method in an attempt to reach an academic achievement. They also showed a statistically-significant difference in attitudes between the two groups.

A further study was done by Basturk (2005) which looked at the effectiveness of SPSS software in teaching introductory statistics at Pamukkale University in Turkey. A quasi – experimental research design was used to compare the learning outcomes of students taught using SPSS and those taught using traditional method. The analysis of midterm and final examination demonstrated that participants in the lecture plus SPSS software obtained higher averages on midterm and final exams than participants in the lecture environment only. These higher averages were likely due to their better performance on concepts and practices that were taught in both regular and SPSS software environment. In addition, when the topics of the introductory statistics course moved from descriptive statistics to inferential statistics, the learning gap between Lecture-only and Lecture-plus-SPSS increased. Findings of this study suggests that participants' learning capacity of the introductory statistics could be improved successfully when SPSS is used as a supplement to regular lecture in teaching introductory statistics course.

These and many more researches demonstrate the fact that SPSS software has a more positive side as a tool for the teaching and learning of statistics in schools and higher learning institutions.

Most of these studies have evaluated the effect of SPSS on students' performance and attitudes toward statistics in high school and graduate students, but no one has focused on a particular topic in statistics like hypothesis testing, especially among business students at the Zambia Catholic University. This study fills in this gap by evaluating the effect of instruction withSPSS on students' achievement and attitude towards hypothesis testing among undergraduate students at the Zambia Catholic University.

3. Methodology

3.1 Research Design

A research design is a plan or strategy which moves from the underlying philosophical assumptions to specifying the selection of respondents, the data gathering techniques to be used and the data analysis to be done (Maree, 2007). This study is all about the effect of instruction with SPSS on students' achievement in hypothesis testing. The study employed a randomized pre-test post-test experimental research design. The effect of instructions with SPSS was assessed by comparing the performance of the experimental group and the control group

3.2 Research site/Location

This study was done at the Zambia Catholic University which is located in Kalulushi District of the Copperbelt Province in Zambia. Zambia Catholic University is a private University which is run by the Catholics.

3.3 Target/ Study Population

The population of this study was made up of all(51) second year full time students taking STAT210 which is a compulsory statistics course to all second year students at Zambia Catholic University.

3.4 Sample and Sampling Techniques

The sampling technique was done by using the total sampling where all students who took STAT210(a statistics course) were taken as participants. The researcher used the whole class consisting of 51 second year full time students doing STAT210(a statistics course) from Zambia Catholic University. Forty-eight(48) students participated in the research process because 3 students did not take part in the pre- test. These sample members were randomly assigned to two (2) groups the experimental group and the control group.

3.5 Data Collection Procedure

The researcher used 3 instruments for data collection: hypothesis testing Pre-Test (HTPreT), Hypothesis testing Post Test (HTPT) and a questionnaire which is the survey of attitude towards hypothesis testing (SATHT) to measure the attitude of students towards hypothesis testing. Two instruments HTPreT and SATHT were used during pre-test period given to both control and experimental groups. After the pre-test, hypothesis testing was taught with two different methods. The researcher taught hypothesis testing by using SPSS to the experimental group. Students in the control group were taught hypothesis testing using traditional teaching methods. Before the intervention period, the researcher prepared two lesson plans. The first lesson plan involved teaching with SPSS while the second lesson plan was prepared using the traditional methods. After the intervention, post-test was conducted using hypothesis testing post-test HTPT and survey of attitude towards statistics SATHT for both groups.The survey of attitude towards hypothesis testing (SATHT) was divided into four (4) subscales: Interest, value, effort and competence.

3.6 Data Analysis Procedure

Independent samples t-test statistics were conducted for HTPreT and HTPT scores of both groups to determine whether there were significant differences between the experimental and the control groups.

Independent samples t-test statistics was conducted to determine whether there was a statistically significant post-test score differences on average between male and female students within the experimental group.

In order to determine whether there was a statistically significant effect of the intervention on the students' attitude towards learning hypothesis testing with SPSS, independent samples t-tests was conducted for SATHT pre-test and post-test scores to find the size of the impact for control and experimental groups for each subscale.

4. Results

4.1 The effect of SPSS on students' achievement in Hypothesis testing

In order to determine the effect of SPSS software on students' achievement in Hypothesis testing, independent samples t-test statistics were conducted for both HTPreT and HTPT. See Table 4.1.

Table 4.1: Independent Sample t-test for experimental and control groups in HTPreT and HTPT

	Group	n	Mean	SD	Mean Difference	t-value	df	P-value
HTPreT	EG	24	11.46	4.961	0.583	0.377	46	0.708
	CG	24	10.88	5.720				
HTPT	EG	24	64.13	16.638	11	2.504	46	0.016
	CG	24	53.13	13.652				

Table 4.1 above shows that there was no statistically significant difference between the control group and the Experimental group with respect to their HTPreT scores on average: t=0.377, p= 0.708 > 0.05. Thus, students in both groups were assumed to have a similar level of knowledge on Hypothesis testing before the intervention. However, Table 4.1 also shows that there was a statistically significant difference between the control group and the experimental group with respect to the HTPT scores on average: t = 2.504, p = 0.016 <0.05. According to this finding, the researcher rejected the null hypothesis. The researcher therefore concluded that there was a statistically significant difference between the groups in HTPT in favour of the Experimental Group. Thus, it was found that the students in the experimental group had a better achievement in hypothesis testing at the end of the intervention.

4.2 Influence of SPSS on achievement by gender

In order to determine whether there was a difference in achievement between male and female students in the experimental group after teaching hypothesis testing using SPSS, independent samples t-test statistics were conducted for HTPT. See Table 4.2.

Table 4.2: Independent samples t-test for the experimental group by gender in HTPT

Gender	n	Mean score%	SD	Mean Difference	df	t-value	P-value
Male		15	62.60	4.07	22	-0.571	0.574
Female		9	66.67				
Total		24	64.63				

Table 4.2 shows that there was no statistically significant difference between female and male students in the experimental group with respect to their HTPT scores on average: t = -0.571, p= 0.574 >0.05. According to this finding, the researcher did not reject the null hypothesis. The researcher therefore concluded that there was no statistically significant difference between female and male students in the experimental group with respect to their HTPT scores. Thus, both female and male students in the experimental group were assumed to have a similar level of achievement in hypothesis testing after the intervention, meaning that both male and female students benefited from using SPSS software while learning Hypothesis testing.

Table 4.3: Independent samples T-Test statistics for SATHT items

	Groups	n	mean	SD	t-value	df	P-value
PreINTERE	Control	24	13.75	1.775	-1.366	46	0.176
	Experimental	24	12.96	2.216		46	
PreVALUE	Control	24	13.50	2.604	-0.057	46	0.955
	Experimental	24	13.46	2.431		46	
PreEFFORT	Control	24	10.54	1.444	0.304	46	0.762
	Experimental	24	10.67	1.404		46	
PreCOMP	Control	24	10.54	1.978	0.512	46	0.611
	Experimental	24	10.83	1.971		46	
PostINTERE	Control	24	14.58	1.530	1.233	46	0.224
	Experimental	24	15.13	1.513		46	
PostVALUE	Control	24	10.17	2.120	0.731	46	0.468
	Experimental	24	10.58	1.816		46	
PostEFFORT	Control	24	14.42	1.954	0.457	46	0.650
	Experimental	24	14.67	1.834		46	
PostCOMP	Control	24	9.75	1.595	7.353	46	0.000
	Experimental	24	12.79	1.250		46	

Table 4.3 shows that there were no statistically significant differences between the control group and the experimental group with respect to PreINTERE, PreVALUE, PreEFFORT, PreCOMPE, PostINTERE, PostVALUE, PostEFFORT scores on average. However, there was a statistically significant difference between the control and the experimental groups with respect to PostCOMPE scores on average: t=7.353, P=0.000<0.05. Thus, it was found that the students in the experimental group had better attitude towards learning Hypothesis testing at the end of the intervention in terms of their intellectual knowledge and skill when applying hypothesis testing.

5. Discussion of Findings

1. Students in the experimental group performed better than students in the control group on average in terms of scores in HTPT. When independent samples t-test statistics was conducted for HTPT; there was a statistically significant difference between experimental group and control group (p=0.016<0.05) in favor of the experimental group.The explanation to this finding can be linked to multiple representations theory (enactive, iconic, and symbolic stages), zone of proximal development and scaffolding. SPSS intervention facilitated learning abstract statistical concepts.SPSS acted as the scaffold which enabled students to reach their zone of proximal development (Vygotsky, 1978).Additionally, the teacher and more competent students also played a part in the scaffolding process and these can bereasons students in the experimental group outperformed students in the control group. This finding is also supported by other researches (Ryan, 2016; Gomez, 2010). In fact, the

evidence for the using specialized statistical software, SPSS software in particular provides teachers with tools to use the multiple representation stages simultaneously or one after the other.

2. Male and Female students in the experimental group did not differ significantly in terms of scores in HTPT. When independent samples t-test statistics was conducted for students with respect to gender in the experimental group, there was no statistically significant difference between them (P=-0.571>0.05).It was established that SPSS software benefited both male and female students.

The possible explanation to this finding can be attributed to the fact that both male and female students in the experimental group were exposed to the same technology-rich learning environment. SPSS gave both male and female students an opportunity to work on the concepts of hypothesis testing through exploration and visualization. SPSS encouraged a more interactive teacher-student as well as student-student interactional environment where everyone worked as a team to help and assist one another to reach the required learning objectives. SPSS acted as an important scaffold for both male and female students to bridge the gap that exist between what a learner can do on his or her own and what he or she can do with the help of more knowledgeable others. These findings revealed that SPSS learning environment gives equal chances of learning to both male and female students. This study also revealed that SPSS environment allows male and female students to learn statistics at the same level and the result of this is gain for both male and female students without bias. Therefore, it was established that SPSS is non-discriminatory on gender.

This finding is in agreement with similar studies done on the impact of SPSS on male and female students' achievement in statistics. Petoczconducted a research in 2001 on the learning of statistics using SPSS. This researcher observed that both male and female students in the SPSS teaching environment achieved equally in statistics. Mwingirwa (2016) established that the technology environment gives a competitive environment for both girls and boys at the same level which results in gain for both male and female with no bias.

3. Students in the experimental group outperformed students in the control group on average in terms of scores in attitudes towards Hypothesis testing on cognitive competence. When the independent samples t-test statistics was conducted for PostCOMPETE, there was a statistically significant difference between experimental groups and the control groups (P=0.000<0.05) in favour of the Experimental group.
The possible explanation to this finding can be linked to the following reasons: (a) SPSS facilitates learning and students find learning hypothesis to be easy and straight forward; (b) SPSS enhances visualizations and renders the topic tangible; and (c) SPSS is more appealing to students' learning styles due to its multiple representations features (Jatnika, 2016). This finding aligns with the study done by Jatnika in 2016 in China. The purpose of the study was to evaluate the effect of using SPSS software on students' performance and attitude in statistics. This researcher concluded that the students' knowledge and skill when applying statistics increased after learning using SPSS software.

6. Conclusion and Recommendation

6.1 Conclusion

This study concludes that SPSS is one sure solution to the poor performance on questions involving hypothesis testing as it enhances understanding of statistics concepts. As regards gender equity, this study concludes that SPSS benefited both male and female students in learning hypothesis testing. This study also concludes that SPSS enhances students' attitude toward learning hypothesis testing with technology.

6.2 Recommendations

Arising from the findings of this study the researcher recommends that statistics educators in Zambia should be encouraged to incorporate statistical soft wares such as SPSS in their classrooms and they should be able to use them effectively and systematically.

Teaching Colleges and Universities should train prospective teachers and lecturers for adequate and effective use of statistical soft wares such as SPSS in statistics teaching.

6.3 Recommendations for Further Research Studies

This study restricted itself to use of SPSS in the teaching and learning hypothesis testing, there is need for further studies to be done to check if SPSS will be useful in other areas of Statistics.

Studies need to be done to establish the usefulness of SPSS software in other levels of learning statistics in Zambia; such as primary and secondary schools.

The quantitative research methodology was adopted in the present study. Therefore, in order to provide in-depth insight into the effects of SPSS software on students' achievement and attitude towards learning hypothesis testing in Zambia, qualitative research methodologies, such as observations and interviews are also recommended to be used.

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