



**ORIGINAL RESEARCH PAPER**

**Statistic**

**Comparative Statistical Analysis of Examination Performance of Namibian and Indian Students**

**KEY WORDS:** Examination Results, Difficulty Index, Discrimination Index, Reliability Tests (Cronbach's

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**ABSTRACT**

Education is the process of facilitating learning, or the acquisition of knowledge, skills, values, beliefs and habits. Examination results are very important for many students with regard to their future profession development. Results of exams should be carefully inspected by the teachers to help improve design and evaluation of tests and the education process in general. Namibian students undergoing graduation courses in India has increased. Many companies show interest in employing life sciences students. Namibian students prefer to study in India because of advantages of availability of institutes of excellence in higher education that provide good quality education, personal growth, broader understanding of the world, start-up career, lower cost of living, melting pot of diverse culture and better and more lucrative employment offers. Students have been showing greater interest on life science courses. To understand the performance between Indian and Namibian students in different subjects, their total marks secured in theory exam were analysed using several parameters like difficulty Index, discrimination index, reliability test and independent t- test were investigated. The Examination results of total scores approximate to normal distribution both Namibian and Indian students thus it was concluded that the design of the examination paper was good for Namibians and Acceptable for Indians.

**Introduction**

Education is a vital tool that is used in the contemporary world to succeed. The knowledge that is attained through education helps open doors to a lot of opportunities for better prospects in career growth. India boasts one of the largest education systems with top ranking universities, which is apparently one of the top reasons for foreign students to study in India. In education, examination is a test to show the knowledge and ability of a student. Examination, final results act as an important part of a student's life. The purpose of these activities is to assess student's knowledge related to a subject (Borozova, 2014). The statistical analysis of examination results is an important work for the management of examination. Its conclusions are the theoretical basis for teaching evaluation, research and reform. By analyzing examination results, the teachers can get to know how much knowledge students have obtained. On the other hand, it can be a feedback to improve the quality of examination papers, which is beneficial to modify the questions and make the exams more standardized. Therefore, statistical analysis of the examination results has been suggested for identifying the problems in the examination system as well as in the teaching process of a university (Yuan W et al., 2012).

In this paper, comparative study between Namibian and Indian students are made by taking their Examination Results of subjects that were common for both Namibian and Indian students. Analysis are made with respect to the level of difficulty, discrimination capability, difficulty of a question paper and reliability of the examination. Analysis of examination papers was done in different subjects taken by students of Under Graduate (UG) courses at Department of Water and Health, Faculty of Life Sciences, JSS University from 2013-2016 academic years with Choice Base Credit System (CBCS) regulation pattern. Thus, helping out to plan effective teaching-learning methodologies and assessment methods.

**Material and Methods**

**Data description**

The performance of Namibian and Indian students in university examination for all different subjects was available for analysis. The

examination results of first four semester undergraduate students from academic years 2013-2016 at JSS University, Department of Water and Health, Faculty of Life sciences was available. Here, there are three courses (Biotechnology, Microbiology and Environmental science), with common papers attended by the students have been analysed. In first semesters two common subjects i.e. Fundamentals of Statistics (FOS) for 75 marks, Environmental science (EVS) for 50 marks. In second semester, two subjects have been compared Fundamentals of Biochemistry (PBC) for 75 marks and English for 100 marks. In third semester, Fundamentals of Bioinformatics (BIF) for 75 marks, Fundamentals of Computers (BCT) for 100 marks. In fourth semester Fundamentals of Nano science and technology (FNT) for 75 marks, Tissue Culture (TC) for 100 marks is considered for both Namibian and Indian students.

**Methods used for analysis of the tests**

In this study we use the following methods for comparative analysis of the performance of examination for Namibian and Indian students. In order to check the consistency of the students performance in the examination, different test criteria are adopted in order to know

1. Whether the variables (subjects), were too difficult or too easy, Difficult Index is tested.
2. The quality of the variables (subjects) is determined in terms of the Discrimination Index.
3. In order to test for reliability and consistency between and within the subjects, reliability test is considered.
4. Test the significant difference between the mean scores for Namibian and Indian students by using Independent t-Test.

**Difficulty Index**

Difficulty index (P) is a measure to check the variables (subjects), were difficult or easy which is given by the formula

$$P = \frac{S_{max}}{S_{min}}$$

Where, Ssum is a total sum of scores obtained by all students; Smax is a maximum total number of scores

Difficulty index usually range between  $0 < P < 1$ . Generally, If P is more than 0.7, it indicates that the exam is quite easy. If P is in between 0.5 - 0.7, it is moderate and if less than 0.5, the exam is difficult (BrozovaH. and Rydval J.2014)

**Discrimination Index**

Discrimination index (ULI-Upper-Lower Index) is a measure which is given by

$$ULI = \frac{N_U - N_L}{0.5N}$$

Where; NU = Total scores above or equal to the median, NL= Total scores below the median, N = total number of students. The possible range of the discrimination index is -1 to 1. The subjects are qualified if the discrimination index is greater or equal to 0.25. If it is greater or equal to 0.15, then it is considered to be moderate, and less than 0.15, it is difficult.

**Reliability of the test (Cronbach's alpha test)**

Estimates of reliability (Cronbach's alpha) are at the heart of the quality control process of the examination system. It is a measure used to calculate the internal consistency .Cronbach's alpha can be calculated by following formula (W. J. Yuan et al. 2012)

$$\alpha = \frac{k}{k-1} \left( 1 - \frac{\sum s_i^2}{s^2} \right)$$

Where  $s_i^2$  = Variance of the  $i^{th}$  test items score,  $s^2$  = Variance of the test score, k= Total of item

The value of the alpha coefficient of reliability varies from  $0 < \alpha < 1$ , if  $\alpha = 0$  means no consistency and if  $\alpha = 1$  means perfect consistency but it will rarely happen. Meaning of values of Cronbach's alpha are follows: [0.9, 1] - Excellent, [0.8, 0.9]-Good, [0.7, 0.8]- Acceptable, [0.6, 0.7]- Questionable, [0.5, 0.6] -Poor, [0, 0.5]- Unacceptable.

**Independent t-test**

The independent t-test, also called the two sample t-test, is an inferential statistical test that determines whether there is a statistically significant difference between the means in two independent groups. Independent t-test involves examination of the significant differences on one factor or dependent variable(i.e Total Scores) between means of two independent groups (e.g., Namibian vs. Indian) by using formula as follows.

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{\sum(x_1 - \bar{x}_1)^2 + \sum(x_2 - \bar{x}_2)^2}{n_1 + n_2 - 2} \left[ \frac{1}{n_1} + \frac{1}{n_2} \right]}}$$

Where  $\bar{X}_1$  = Mean of Namibians,  $\bar{X}_2$  := Mean of Indians  
 n1= Number of Namibian students, n2= Number of Indian students

**Results**

**Basic univariate analysis**

A total of 310 Namibian and 232 Indian students were involved in this study. Based on the data of examination results, frequency distribution of total percentage scores for Namibian and Indian students for all 8 subjects is shown in Figure1 (a)-(b). The results indicate that the distribution of examination scores approximate to normal distribution with the scores fitting into the formal tests of normality based on skewness and kurtosis values. The number of Namibian students with total percentage scores in between 60-69 is more and also more uniform than Indian students; further there were no student with scores less than 40. Whereas, among Indian students, 6 % scored more than 90-100 and 2 % scored less

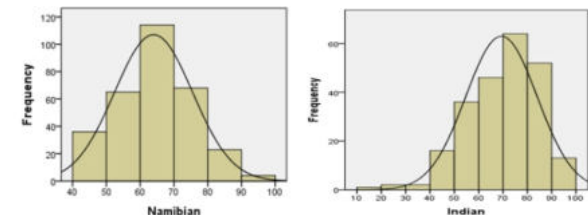
than 0-40. Indicating extremes of good performance and poor performance. Table1 provides the descriptive statistics, the average total percentage scores and standard deviation for Namibian students is  $63.96 \pm 11.56$  % and Indian students is  $69.35 \pm 14.96$  % . This indicates that, in the performance of the Namibian students there is less variation than Indian students.

After observing the Namibian students data, it was noticed that, the minimum percentage was 40% and maximum was 97% for which the range was found to be 57%. Therefore, it is concluded that there is normal distribution in the performance of the Namibian students. Similarly, results of Indian students were analysed and found that the minimum percentage secured by the students is 19% and the maximum is 99% and the range is 80%. This curve is more peaked than the normal curve hence it is known as Leptokurtic curve. While comparing Namibians as well as Indians result; it is observed that even though both examination results obey the normative rule, the peakedness is higher in Indians when compared to Namibians. The frequency is higher in Indians and below the average, whereas in the Namibians the frequency is less. From this it is concluded that the performance of the Namibian students is moderate and consistent when compared to Indians.

**Table1:** Descriptive Statistics of total percentage score obtained for all subjects of Namibian and Indian students from the Academic year 2013-2016.

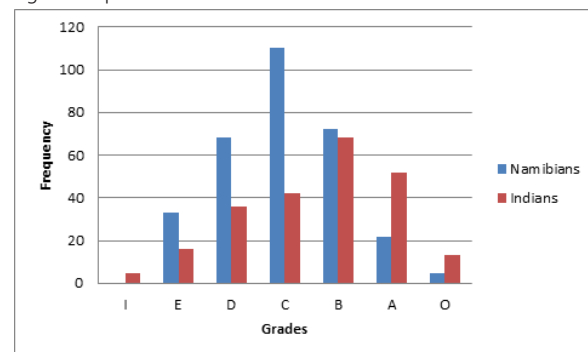
Descriptive Statistics	Namibian	Indian
N	310	232
Mean	63.96	69.35
Median	64.00	71.00
Standard Deviation	11.56	14.69
Skewness	0.082	-0.583
Kurtosis	-0.163	0.174
Range	57	80
Minimum	40	19
Maximum	97	99

**Figure1:** Normal curve depicting the frequency distribution of total percentage score obtained for all subjects of Namibian and Indian students from the Academic year 2013-2016.



a) Total percentage scores for all subjects of Namibian b) Total percentage scores for all subjects of Indian

**Figure2:** Namibian and Indian students of grades from the academic year 2013-2016 with Choice Base Credit System (CBCS) regulation pattern.



From Figure2, we observe that Majority i.e., 35% of the Namibian students obtain a grade C with range of 60-70, around 2%

perform outstanding and there were no Namibian students less than 40 with grade I. For Indians, majority i.e.29% of the students obtain B grade with range 70-80, around 6% of the students perform outstanding with range 90-100. We can also notice that 2% of the students are below 40%.

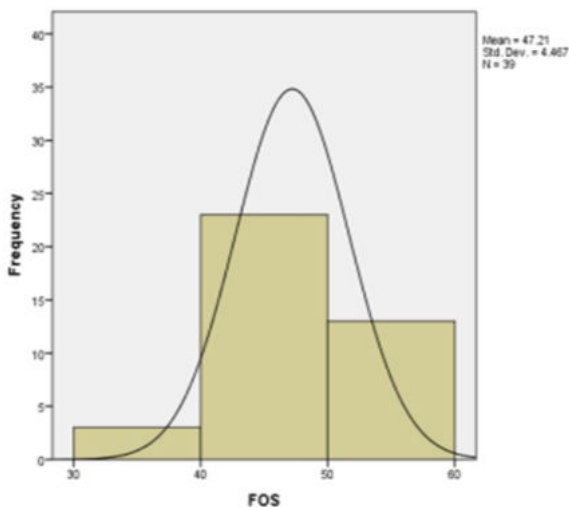
**Table2:** Descriptive statistics for Namibian and Indian under graduate students with respect to total scored marks in different subject examination from academic year 2013-2016.

Variables	Mean Total Scores Mean±S.D		Median		Range		Skewness	
	Namibia	India	Namibia	India	Namibia	India	Namibia	India
FOS	47.21 ± 4.47	44.08± 10.80	48	44	20	47	-0.62	-0.66
EVS	32.46 ± 3.70	38.08 ± 6.39	32	39	20	29	-0.64	-1.0
ENG	71.64 ± 4.96	68.20± 12.79	71	71	20	41	-0.19	-0.23
PBC	36.97 ± 6.10	50.36± 13.87	37	51	22	54	0.63	-0.10
BIF	44.08 ± 4.55	54.10 ± 7.30	44	53	21	24	0.08	0.47
BCT	56.29 ± 8.55	72.45 ± 8.45	55	71	39	33	0.75	-0.71
FNT	57.69 ± 6.55	56.00 ± 7.31	58	57	26	30	0.31	-0.67
TC	70.56 ± 11.68	73.00± 15.90	70	79	41	60	0.65	-0.73

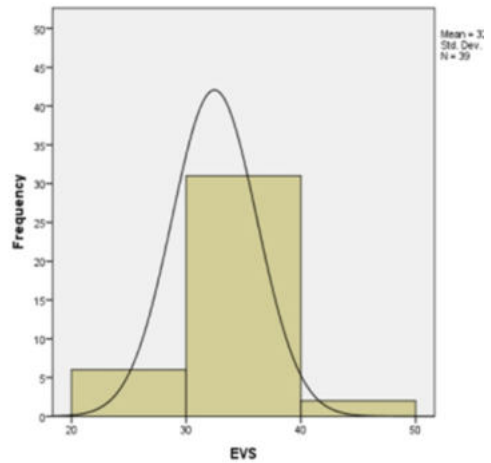
Descriptive statistics of the scores obtained for different subjects i.e. FOS, EVS, ENG, PBC, BIF, BCT, FNT, and TC by Namibian and Indian students is presented in Table 2. The Namibian and Indian students average total score and standard deviation for different subject were as follows: FOS was 47.21 ± 4.47 and 44.08 ± 10.80 for 75 marks; EVS was 32.46 ± 3.70 and 38.08 ± 6.39 for 50 marks. ENG 71.64 ± 4.96 and 68.20 ± 12.79 for 100 marks, PBC was 36.97 ± 6.10 and 50.36 ± 13.87 for 75marks, BIF was 44.08 ± 4.55 and 54.10 ± 7.30 for 75, BCT is 56.29 ± 8.55 and 72.45 ± 8.45 for 100 marks, FNT is 57.69 ± 6.55 and 56.00 ± 7.31 for 75 marks, TC 70.56 ± 11.68 and 73.00 ± 15.90 for 100 .We notice that the skewness values are all lies between -1 to +1 it indicates that the distribution for Namibian and Indian students examination total scores approximate to Normal distribution.

**Figure3:** Histograms with Normal curve depicting the total scores for particular subject (Namibian students.)

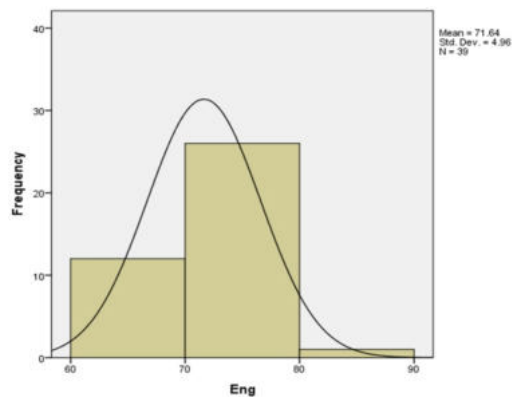
a) FOS



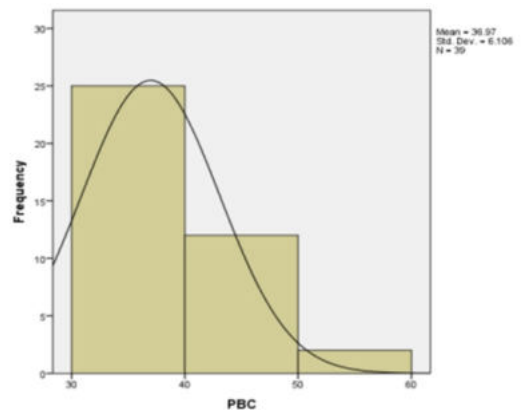
b) EVS



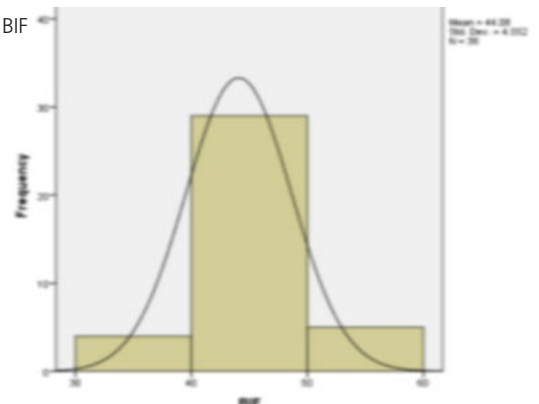
c) ENG



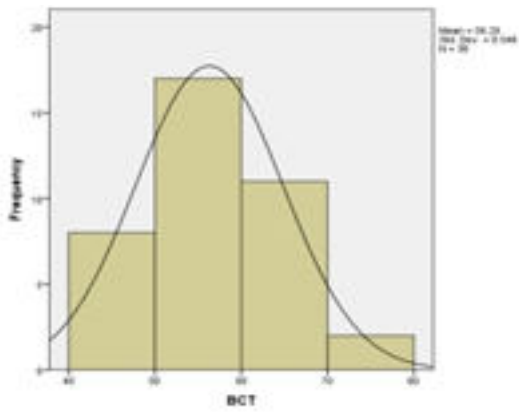
d) PBC



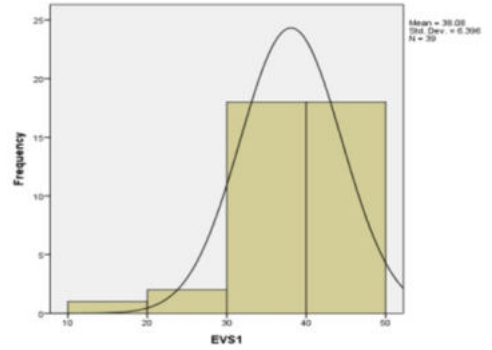
e) BIF



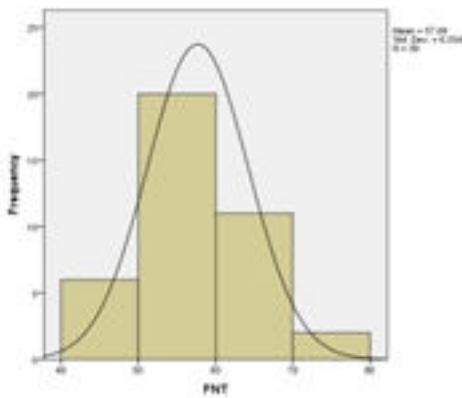
f) BCT



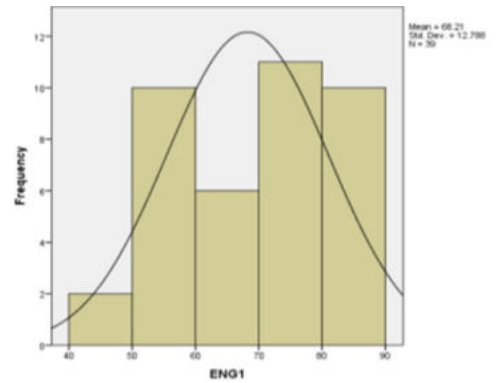
b) EVS



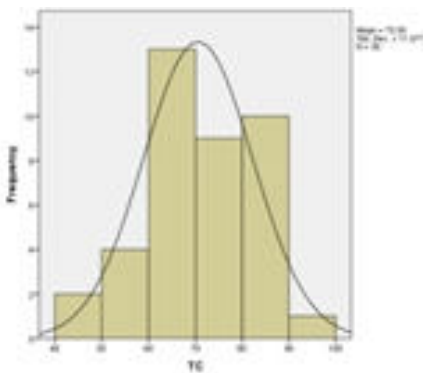
g) FNT



c) EVG



h) TC



d) PBC

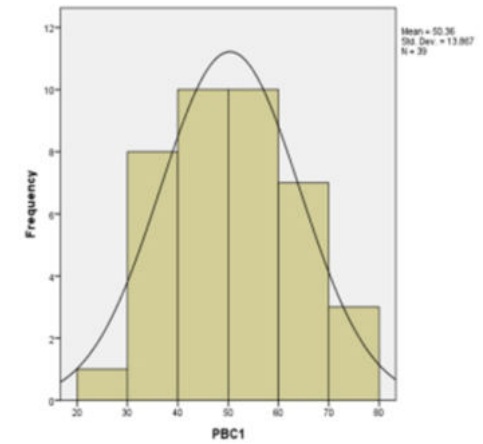
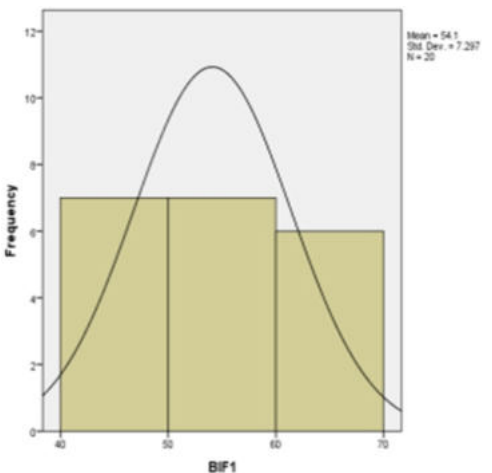
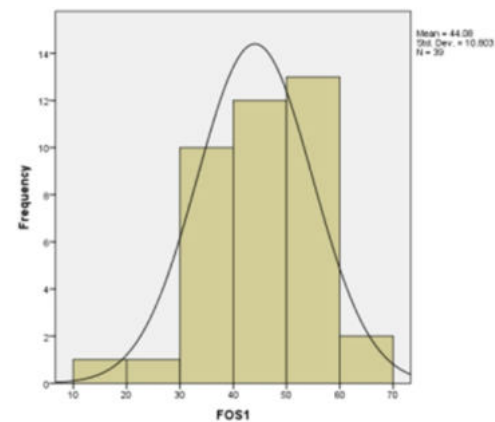


Figure4: Histograms with Normal curve depicting the total scores for particular subject (Indian students)

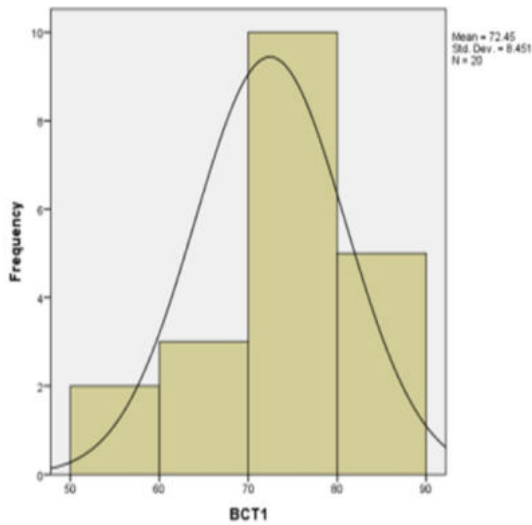
e) BIF



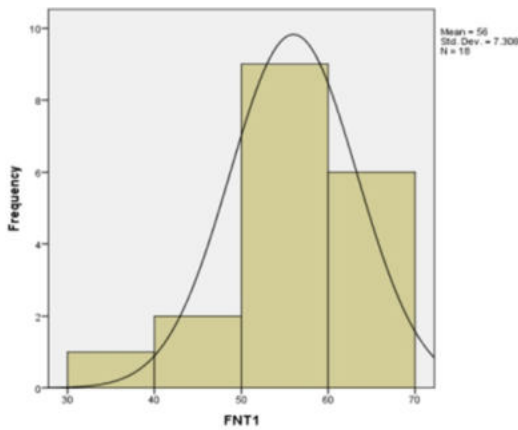
FOS



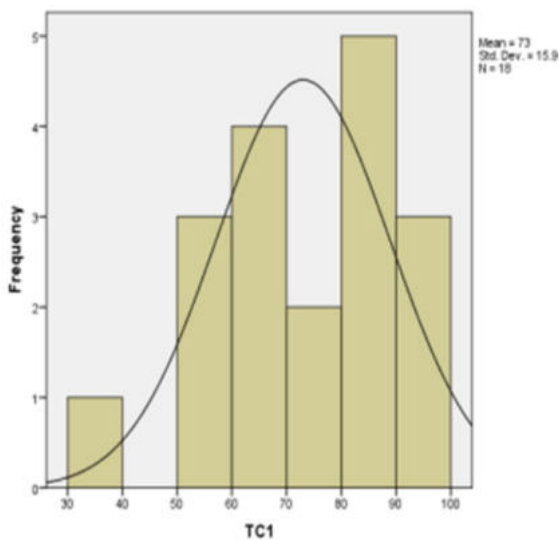
f)BCT



g)FNT



h) TC



Based on histograms it can be observed that obviously the variables follow normal distribution with formal tests of normality based on skewness and all values lies between -1 to +1. The number of total scores with various subject is different as shown in Figures 3(a)-(h) and Figures 4(a)-(h). Compared with other subject, if mean is greater than median, the distribution is described as positively skewed and when mean is less than median, then the distribution is negatively skewed. In this current study, the positively skewed indicating good performance for EVS,

ENG, BIF, BCT and TC whereas negatively skewed for FOS. The symmetric distribution follows in the subjects PBC and FNT, thus it is concluded that there is normal distribution in the performance of the Namibian students as shown in Figures 4(a)-(h). There exists a positive skewness for subjects FOS, BIF and BCT whereas EVS, ENG, PBC, FNT, TC follows the negative skewness.

An Independent t-Test was conducted to calculate the impact of the total scores on Namibian and Indian students. There is significance difference between Namibian and Indian students total percentage score for all subjects,  $t(540) = -4.78$ ,  $p < 0.05$  (two-tailed) with a 95% confidence interval ranging from -7.61 to -3.18.

**Table3:** Difficulty index for Namibian and Indian students from academic year 2013-2016.

Variables	Difficulty index		Conclusion		***p-value
	Namibia	India	Namibia	India	
FOS	0.63	0.58	Moderate	Moderate	0.10
EVS	0.65	0.76	Moderate	Easy	0.00
ENG	0.72	0.68	Easy	Moderate	0.00
PBC	0.49	0.67	Difficulty	Moderate	0.00
BIF	0.58	0.72	Moderate	Easy	0.00
BCT	0.56	0.72	Moderate	Easy	0.00
FNT	0.77	0.75	Easy	Easy	0.40
TC	0.71	0.73	Easy	Easy	0.56

\*\*\*: P-value obtained by Independent t-Test.

For the given data, the difficulty index ranges between (0.49 - 0.77). From the Table3, we note that for Namibian student, one subject (i.e. PBC) is difficult, four subjects (i.e. FOS, EVS, BIF and BCT) are moderately difficult and in three subjects (i.e. ENG, FNT and TC) are easy. For Indian students, three subjects (i.e. FOS, ENG and PBC) are moderately difficult and five subjects (i.e. EVS, BIF, FNT, BCT and TC) are easy. For these following subjects i.e. FOS (0.10), FNT (0.40) and TC (0.56) are statistically insignificant and EVS, ENG, PBC, BIF and BCT follows significant at 5% level of significance.

With respect to Discrimination Index, two subjects that is EVS (0.56) and ENG (0.36) for Namibians and for Indians BCT (0.60) have values greater than 0.25, indicates that the subjects are easy. For Indians, FOS (0.15) and for Namibians BIF (0.154), which is  $\geq 0.15$ , the subject is moderate to answer. Remaining subjects have score less than 0.15, which is said to be difficult to answer for both Namibian and Indian students.

From Cronbach's, alpha test, which was estimated according to equation, including eight items results by  $\alpha = 0.8$  for Namibians and  $\alpha = 0.7$  for Indians. It does not show a high reliability test because the reliability tests have the Cronbach's alpha near to 1 which shows the exam is very easy. But we can say that the quality of the exam paper is acceptable for Indians and Good for Namibians.

**Conclusion**

Analyzing the examination performance for the students of two different countries by using statistical analysis for the exam. The results indicate that the distribution of examination total scores approximate to normal distribution. While testing for Difficulty Index, for Indian, five subjects are easy (i.e. EVS, BIF, FNT, BCT AND TC) and for Namibian, three subjects are easy (i.e. ENG, FNT and TC) and with respect to discrimination index, for Namibian two subjects are easy and for Indians one subject is easy to answer. By Reliability test, the exam paper is acceptable for Indians and Good for Namibians. By Independent t-test, we conclude that there is significant difference between Namibian and Indian Students with respect to total percentage score. Thus it was concluded that the design of the examination paper was good for Namibians and Acceptable for Indians.

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