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Full Length Research Article

RELATIONSHIP BETWEEN SEASONAL WEATHER VARIATION AND STUDENTS' ACADEMIC PERFORMANCE IN KADUNA STATE UNIVERSITY, NIGERIA

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ABSTRACT
The study assessed the relationship between seasonal weather variation and students' academic performance in Kaduna State University (KASU), Kaduna State, Nigeria. The study involved the two campuses of KASU in Kaduna and Kafanchan. Academic Performance data was obtained from the academic office, meteorological data was obtained from NiMET while survey data was obtained using a structured questionnaire administered to 309 randomly selected student'. Data was analyzed using descriptive statistics and the Z – test Statistic. The study found out that seasonal weather variations occur in an academic session as revealed by NiMET data (2008 - 2018) and affected the academic performance of majority of the students (180) 58.3% negatively while (129)41.7% were not affected. The study recommended that mitigation and coping measures should be instituted during the second semester which coincides with peak rainfall to reduce its negative effect on students' academic performance and a new calendar which avoids the peak weather periods in August, January and April should be designed and utilized as soon as possible to improve students' academic performance in KASU.

Keywords: Academic, Performance, Seasonal, Students, Variation, Weather

INTRODUCTION

The effect of weather on the environmental conditions in which human institutions operate to meet societal needs is enormous. As weather variables change and become more severe daily activities are impacted in one way or another (Braswell, 2018). Seasonal weather variables either enhance or hinder their ability to function properly in terms of conducting their activities without hindrance (World Health Organization, 2004). According to Phan (2021) mental functions may be negatively affected by decreases in thermal comfort as a result of large differences in temperature in the classroom among students as the heat season peaks. During harmattan some students are unable to attend due to the dust and harsh winds. In addition, asthmatic students avoid the dust so as not to trigger an attack on their health status (Jamila *et al*., 2018).
As students' go about their daily activities variations in weather can adversely affect their performance. This is disruptive in tertiary institutions where academic activities are rigorous and intensive involving long hours of lectures, assignments, reading, research and publications, presentations and laboratory work (Hyndman, 2017). Therefore, the net effect is seen in lower academic performance due to climatic variation and effect of rainfall, heat, humidity and wind especially at peak periods (Hyndman, 2017). Anderson (2011) agreed that severe weather is a serious threat to efforts aimed at reducing the effects of seasonal weather variations on human activities due to the phenomenon of climate change. Therefore, any phenomenon natural or not that affects the smooth running of academic activities and impacts students' performance is not in the best interest of students, lecturers, management and socio-economic development of the nation which depends on the successful training of needed manpower from tertiary institutions (Monguno and Monguno, 2017).
Performance indicated by academic performance is crucial for educational attainment at the tertiary level. Therefore, understanding how seasonal weather variations affect student performance is crucial to finding appropriate solutions and adaptation strategies to achieve and maintain optimum academic performance among students of tertiary institutions (Tambaya and Francis, 2017). However, research on this phenomenon that focuses on Kaduna State University is lacking. This paper therefore seeks to address the issue and generate beneficial knowledge and information to all stakeholders in the educational sector by achieving the following objectives: (i) assess the perception of students on relationship between seasonal variations and students' academic performance in KASU; and (ii) identify months to be avoided in designing an improved academic calendar in KASU.

RESEARCH METHODOLOGY

Study Area Location

The study was carried out in Kaduna State University using the two campuses located at Kaduna and Kafanchan campuses. Kaduna State has a population of over 6 million with several tertiary institutions scattered around the State (National Population Commission, 2006). Kaduna State has a projected population of 7,331,283 at 2.5 percent base rate. Kaduna State is located between latitude 09° 02″ and 11° 32″ north of the Equator and longitudes 06° 15″ and 08° 50″ East of the Greenwich meridian. Kaduna State has a relief of between 650 to 700 metres above sea level in some places and much lower in some (Iloeje, 2001).

Types and sources of data

i. Student examination record data

The examination results of 309 students from selected faculties were obtained which enabled the researcher analyze the data in relation to weather variations for both the first and second semesters. The data from examination records spanned from 2012 – 2018. The types of data used include semester Grade Point Averages (G.P.A.) and session cumulative Grade Point Averages (C.G.P.A.).

Meteorological data
Meta data obtained was resolved using descriptive statistics for the period 2008 – 2018. Meteorological data used was for a ten-year period 2008 – 2018. The data included all rainfall, wind and temperature records viewed as important in influencing students' academic performance from the Nigeria Meteorological Agency (NiMET) official documents.

ii. Survey data
This data was obtained through the administration of a structured questionnaire among 309 randomly selected students of KASU.

Sampling Procedure
A multistage sampling technique was used to obtain information on perception for the study. The number of students in Kaduna State University is 12,000 consisting of both undergraduate and postgraduate students (Student Affairs and Records Office KASU, 2018). There are a total of seven faculties in KASU but six were purposively selected because they operate the semester system while the faculty of medicine was excluded because it runs an annual (sessional) academic system. The total population of the study is 12,000 while 3.23 percent of the population is the sample frame which is 387 from which 309 students were randomly selected from four selected faculties in KASU including two each from the Kaduna and Kafanchan campus. The sample frame determination using the Slovian formula was calculated as follows:

$n_o = \frac{N}{1+N\,(e^2)}$

Where: n_o = sample size; e = 0.05; N = total number of observations. Therefore:

$n_o = \frac{N}{1+N\,(e^2)}$

$n_o = \frac{12{,}000}{1+12{,}000\,(0.05 \times 0.05)}$

$n_o = \frac{12{,}000}{1+12{,}000\,(0.0025)}$

$n_o = \frac{12{,}000}{1+30}$

$n_o = \frac{12{,}000}{31}$ =. Therefore, n = 387, i.e., 3.23% of the sampling frame of which a sample size of 309 will be randomly selected from four faculties.
A sample size of n = 309 satisfies the central unit theorem which asserts that, a sample size of at least n = 30 is large enough to ensure a normal distribution in the sampling process.

Table 1: Sampling Technique and Sample size

Tertiary Institution	Faculty	Student Population (Sampling frame)	sampling frame (3.23% of population)	Sample size (selected four faculties)
KASU, Kaduna				
	Agricultural Science	2600	83	83
	Social science	3020	98	98
	Environmental Science	1760	57	57
	Science	2200	71	71
	Arts	1900	61	--
	Pharmaceutical Science	520	17	--
Total		**12,000**	**387**	**309**

Source: Student Affairs and Records Office KASU (2018)

Statistical Techniques

Descriptive Statistics
Objective (ii) was achieved using means, percentages and frequencies, to summarize data.

Z - test statistic
The Z - test which was used to achieve hypothesis one is expressed as follows:

$$Z = \frac{\overline{X}_1 - \overline{X}_2}{\sqrt{\frac{S_1}{n_1} + \frac{S_2}{n_2}}}$$

Where Z = the calculated **Z –** value
$\overline{X}_1$ = mean of results in first semester, $\overline{X}_2$ = mean of results in first semester. $\mathbf{S_1}$ = Standard deviation of results in first semester, $\mathbf{S_2}$ = Standard deviation of results in second semester, $\mathbf{n_1}$ = number students in first semester, $\mathbf{n_2}$ = number students in second semester.

Effects of seasonal variation (Expected Outcome)
Academic performance of students measured in number of passes, Grade Point Average (GPA), Grade Point Average (CGPA) and class of degree

RESULTS AND DISCUSSION

Relationship between Seasonal Weather Variations and Students' Academic Performance

Table 2: Experience of Seasonal Weather Variability in an Academic Calendar

Variable	Frequency (n=309)	Percentage (%)
Harmattan	309	100.0
Rainy season	309	100.0
Hot dry season	309	100.0
Total	309	100.0
Variable	**Frequency**	**Percentage (%)**
Yes	309	100.0
No	0	0
Total	309	100.0

Author's Field Survey, 2019

Table 2 above shows that all the students (309) 100 percent are of the view that there are weather variations during the course of the academic session in KASU. The table also reveals that all the students (309) 100 percent observe the harmattan, rainy and hot dry seasons in an academic session. The results are consistent with the weather variations that occur within the cycle of 365 days in the study area as established by NiMET (2018).

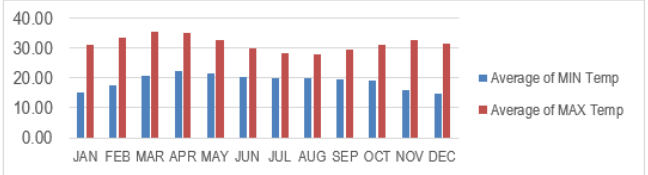

Figure 1: Average Monthly Distribution of Minimum and Maximum Temperature 2008 – 2018
Source: NiMET 2018

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Figure 1 reveals that March received the highest maximum temperature of about 36°C. The month of August received the least average temperature of about 27°C, which the temperature has been influenced as a result of rainfall intensity. For the minimum temperature, the highest is in the month of April and the lowest is in the month of January. Figure 1 also, clearly shows that as the maximum temperature increases so also the minimum increase except in the month of October and November that the maximum and the minimum move on different direction.

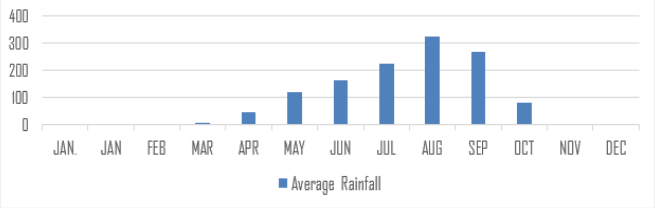

Figure 2: Average Monthly Rainfall Distribution (2018)
Source: NiMET 2018

Figure 2 shows that the highest rainfall received is in the month of August, with average value of about 330mm while the least was received in month of March with the average value of less than 10mm. This confirms the results in figure 1 which shows that the of month of March and April have high temperature and also the time at which the Sun is at the tropic of Capricorn, making the continental Air mass to be the dominant wind in the study area. However, around June and July, the Sun is around the tropic of cancer making maritime air mass to be the major prevailing wind, which brings more rainfall to the study area

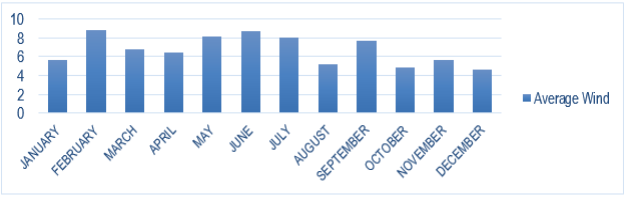

Figure 3: Monthly Distribution of Wind (2018)
Source: NiMET 2018

Figure 3 shows that the highest wind received is in the month of February while the least is recorded in December. The wind system is basically affected by the issue of differential heating. Around the month of February, the sun is basically at the tropics of Capricorn making the air to move from the area of Sahara Desert down to the Southern part of the country.

Table 3: Effect of Seasonal Weather Variations on Academic Performance

Variable	Frequency	Percentage (%)
Negative	180	58.3
Not Negative	129	41.7
Total	309	100.0

Source: Authors Field Survey, 2019
Results in Table 2 shows that majority 180 (58.3%) of the students agree that weather variations negatively affect their academic performance while 129 (41.7%) stated otherwise. That the majority are of the view that weather variations affect their academic performance corroborates and confirms the findings of Monguno and Monguno (2017) and Jamila *et. al.* (2018) who found out that peak periods of harmattan, heat and rainfall affect students' academic performance.

Table 3: Seasonal Variations and Student Performance on Semester Bas

Semester most affected	Frequency	Percentage (%)
First	23	7.4
Second	286	92.6
Best performance	**Frequency**	**Percentage (%)**
First	192	62.1
Second	117	37.9
Total	309	100

Findings in Table 3 show students are most affected by seasonal variations and their best performance. The result shows that 286 (92.6%) students which formed the majority were affected most in the second semester while 23 (7.4%) students were affected most in the second semester. The results also show that majority 192 (62.1%) of students recorded their best performance in the first semester while 117 (37.9%) recorded their best performance in the second semester. Students' perception of their performance reflects their responses on the semesters they are most affected by weather variations. The findings reflect the position of Hyndman (2017) who established that bad weather affects school attendance and academic performance among learners severely.

Table 4: Seasonal Weather Variations that Affect Students' Academic Performance

Season	SA	A	UD	D	SD	WT	M	Decision
Harmattan	22	138	53	65	31	982	3.2	significant
Hot Dry season	34	59	56	73	87	807	2.6	not significant
Rainy season	123	82	29	33	42	1138	3.7	significant

Source: Author's Field Survey, 2019

Keys: SA = Strongly Agree, A = Agree, UD = Undecided, D = Disagree, SD = Strongly Disagree, WT = Weighted Total, M = Mean

Results in Table 4 show weather variations that affect students' academic performance most were the rainy season (3.7) and harmattan (3.2). The result also corroborates the position of Hyndman (2017) and Tambaya and Francis (2017) who argued that the harmattan season, rainy season and heat periods are times of the year experienced in Nigeria and Kaduna State is not an exception. During these periods many illnesses such as typhoid fever, cholera, meningitis, flu, whooping cough, pneumonia and tuberculosis are experienced. These variations in seasons and weather characteristics definitely affect receptiveness to information, cognitive abilities and mental capacity which are directly related to academic performance in measured tests and examinations (Teachnology, 2018). This is corroborated by the

submission of Tambaya and Francis (2017) that weather variations disrupt lectures, reduces comfort in class, library and hostels, affects comprehension and leads to poor academic performance.

Table 5: Severe Weather Characteristics Observed in an Academic in Session

Weather characteristic	Yes	Frequency (%)	No	Frequency (%)
High temperature	254	82.2	55	17.8
High humidity	227	73.5	82	26.5
Excessive Sunshine	235	76.1	74	23.9
Rainfall	271	87.7	38	12.3
Wind	179	57.9	130	42.1
Dust haze	231	74.8	78	25.2

Author's Field Survey, 2019

Table 5 above shows that Rainfall (87.7%), High temperature (82.2%) and Excessive Sunshine (76.1%) are the most severe weather characteristics affecting students' while Wind (57.9%) is the least severe. This reveals the relationship between the peak rainfall season which usually occurs in August in the second semester and the low performance recorded generally.

Table 6: Weather Characteristics and Students' Academic Performance

Weather characteristic	SA	A	UD	D	SD	WT	M	Decision
High temperature	64	88	43	65	49	980	3.2	significant
High humidity	22	66	73	75	61	804	2.6	not significant
Sunshine	34	59	116	43	57	897	2.9	not significant
Rainfall	101	93	40	33	42	1105	3.6	significant
Wind	45	35	93	105	41	894	2.8	not significant
Dust haze	47	32	129	43	59	895	2.9	not significant

Source: Author's Field Survey, 2019

Findings in Table 5 show that the weather characteristics which affect the performance of students in order of severity were rainfall (3.6), followed by high temperature (3.2) while high humidity (2.6) was the least. Hyndman (2017), Monguno and Monguno (2017) established that bad weather especially extreme heat and high rainfall affects student academic performance. Some types of weather are indeed inimical to human health and optimum performance in socioeconomic activities (Akuegwu *et al*., 2012).

Table 7: Summation of Selected Students' Result for 2012/2013 - 2017/2018 Session

First semester			Sum First semester			Second semester			Sum Second semester		
Class	F	(%)	Class	F	(%)	Class	F	(%)	Class	F	(%)
1st	70	3.8	Pass	1490	80.4	1st	58	3.1	Pass	1470	79.3
2/1	458	24.7				2/1	453	24.4			
2/2	661	35.7				2/2	611	33.0			
3rd	301	16.2				3rd	348	18.8			
Fail	364	19.6	Fail	364	19.6	Fail	384	20.7	Fail	384	20.7
Total	1854	100		1854	100		1854	100		1854	100

Source: Student Affairs and Records Office KASU, 2018

The result of summation of sampled students for the 2012/2013 - 2017/2018 sessions shown in Table 7 shows that in the first semester 70 (3.8%) students had first class, 458 (24.7%) had second class upper, 661 (35.7%) had second class lower while 301 (16.2%) had third class. For the first semester 1490 (80.4%) students passed their examinations while 364 (19.6%) failed. Results for the second semester show that in the second semester 58 (3.1%) students had first class, 453 (24.4%) had second class upper, 611 (33.0%) had second class lower while 348 (18.8%) had third class. For the second semester 1470 (79.3%) students passed their examinations while 384 (20.7%) failed. An analysis of the two semesters shows that there were more passes and less fail scores in the first semester while there were more fail and less passes in the second semester. A breakdown for the first semester shows 12 more first class, 5 more second class upper, 50 more second class lower, 47 less third class and 20 less fail. In comparison the first semester had 1490 students or 80.4 percent pass rate while the second semester had 1470 or 79.3 percent pass rate compared to the second semester. Furthermore, while the first semester had a fail rate of 19.6 percent the second semester had a fail rate of 20.7 percent. An analysis of the summation of sampled students results for the 2012/2013 - 2017/2018 session shown in Table 7 reveals that the pass rate and therefore the academic performance of student is generally, higher in the first semester and this coincides with the responses of students in Table 6 in which 92.6 percent said they were more affected in the second semester and therefore, less in the first while 62.1 percent said they recorded their best performance in the first semester. This finding is supported by the submission of Kuhtz (2011) and Hyndman (2017) who reported that more than half of school students in the United States of America are affected by rainfall which in the study area commences and reaches its peak in the second semester between the months of May to August (NiMET, 2018).

Table 8: Z - test analysis results on the difference in students' academic performance between the first and second semesters as a result of weather variation.

First Semester				Second Semester						
Class Minimum Score	F	WT	Mean	Class Minimum Score	F	WT	Mean	Mean Difference	T-Calc.	T-Tab
4.5	70	315		4.5	58	261				
3.5	458	1603		3.5	453	1585.5				
2.4	661	1586.4		2.4	611	1466.4				
1.0	301	301		1.0	348	348				
0.99	364	360.36		0.99	384	380.16			1.87	1.64
Total	1854		2.33		1854		2.27	0.06		

Source: Student Affairs and Records Office KASU, 2018 * Significant at 5% ($P \leq 0.05$)

The Z - test results in Table 8 shows the mean for the cumulative first semester results was 2.33 and was more than the second semester which was 2.27 with a mean difference of 0.06 for the two semesters. The calculated T-value was 1.87 while the table T-value was 1.64. The calculated T-value is higher than the table T-value and this means that there is a significant difference in students' academic performance between the first and second semesters as a result of the different weather variations experienced.

Months to be avoided in designing an Improved Academic Calendar in KASU

It has been established from the results of the study that seasonal variations at peak periods and extremity affect students' performance. It is therefore crucial to identify months that coincide with such periods in order to avoid them in designing an improved academic calendar in KASU.

Table 9: Need for Improved Academic Calendar

Variable	Frequency	Percentage (%)
Yes	235	76.1
No	174	23.9
Total	309	100.0

Source: Author's Field Survey, 2019

Results in Table 9 show the distribution of students' responses on the need or otherwise for a new academic calendar to improve students' performance. The results show that an overwhelming majority 235 (76.1%) of students are of the opinion that a better academic calendar should be designed while 174 (23.9%) think otherwise.

Table 10: Months to be avoided in an Improved Academic Calendar

Month	*Frequency	Percentage (%)	Rank
December	191	61.8	6th
January	269	87.1	2nd
April	263	85.1	3rd
May	235	76.0	4th
July	229	74.1	5th
August	287	92.9	1st

Source: Author's Field Survey, 2019 * more than total due to multiple responses

Table 10 reveals that the top three months to be avoided in designing a new academic calendar for KASU according to rank were August 287 (92.9%), January 269 (87.1%) and April 263 (85.1%). However, the two least months to be avoided were July 229 (74.1%) and December 191 (61.8%). The months of August, January and April coincide with the peak periods of the rainfall, harmattan and hot dry seasons (NiMET, 2018).

Conclusion

The study concludes that seasonal weather variations severely affect students' performance. It was also established that the peak periods of rainfall, harmattan and heat are the main periods that affect students' academic performance by disrupting class attendance, disrupting power supply, reducing concentration and inducing illness among students. Also, it was conclusively established that the weather characteristic with the most severe effect on students' academic performance was the peak rainfall period in August and this is corroborated by lower pass rate obtained by students in the second semester. The study therefore, concludes that the second semester is most affected by seasonal variations. A new academic calendar is therefore needed to avoid the peak periods of rainfall, harmattan and heat which are the main weather variables that affect students' academic performance.

Recommendations

In view of the findings of the study the following recommendations are made:

i. It is recommended that mitigation and coping measures should be instituted during the second semester which coincides with peak rainfall to reduce its negative effect on students' academic performance.

The study recommends that, a new calendar which avoids the peak weather periods in August, January and April in addition to ensuring that the first semester begins between Septembers to November while the second semester is between Junes - March should be designed and utilized as soon as possible to improve students' academic performance.

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