

COVID-19 lockdown policy impact on students' psychological, behavioral, and daily routine changes: a case study of Gusau residents in Nigeria

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Abstract. In the exploration of a better approach to managing education sectors in developing nations during the pandemic era, this study attempts to evaluate the impact of the COVID-19 lockdown policy on students' mental health in Gusau, one of the towns in Nigeria, through the investigation of how the students' psychology, behavior, and routine activities were affected by the introduction of lockdown protocols/policy during the COVID-19 pandemic crisis. The investigation was done using a hybrid method that employs a combination of the descriptive and factorial design method, where 201 students participated in the study. Findings from the study indicated that male students were 2% above female; two-third of the students were under-age; the students' attending private schools were 5% above the ones attending public schools; while two-third of the students were attending lower/middle school. The study confirmed that the students' psychology was significantly affected by the lockdown protocols, likewise their behaviors and routine activities. Some factors contributing to the effects were reported. And recommendations were made to the effect for the government to transform Nigeria states' learning system into being a hybrid learning system that would combine the use of both physical and virtual learning platforms at all levels of education, which would go a long way to manage the behavior, psychology, and routine activities of the students better, both during a pandemic and non-pandemic era.

Keywords: COVID-19; Lockdown policy; Students, Education; Pandemic.

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INTRODUCTION

The outbreak of novel coronavirus disease (COVID-19) arose in China, which quickly spread all through the remainder of the world, and it was declared a pandemic by the World Health Organization (WHO) (Liu et al., 2020). It was first detected in December 2019 and has kept on ravaging the whole world. The outbreak began in Wuhan, China (Prem et al., 2020) and has since spread to practically all the world's nations (Ojewale, 2020). Six months since the primary case was accounted for, the quantity of affirmed cases has ascended to more than nine million - 9,633,157. Mortality from the infection is high and was assessed at 490,481 as of 27 June 2020 (Ojewale, 2020). Even though the number of cases was delayed in ascending in Africa, they have been increasing exponentially (Ojewale, 2020), threatening the already weak health structure (Lone and Ahmad, 2020). On 11 March 2020, the World Health Organization (WHO) announced the novel coronavirus, a pandemic disease, because of its spread worldwide and its influence on life and social interaction. Although it began in China, it has quickly spread worldwide, influencing practically all nations of the world aside from secluded islands with few populaces. It has been named a Public Health Emergency of International Concern by the WHO (Ojewale, 2020).

The pandemic has been rising and already transmitted to more than 14 million individuals worldwide, with at least 597,583 deaths as of 19 July 2020 (Yeasmin et al., 2020). To stop the coronavirus transmission, generally, the entirety of the nations has carried remarkable endeavors to initiate the act of "social distancing," subsequently, numerous schools have been closed (Lancker and Parolin, 2020), and classes are moved to home-based distance-learning models (Golberstein et al., 2020). Children are not beyond the grasp of this pandemic, and the most helpless against its intense impacts, as they are compelled to remain at home for stretched out periods because of lockdown and school closure, bringing about a minimal association with peers and diminished the open doors for exploration and physical activities (Jiao et al., 2020). These antagonistically impact children's emotional well-being prompting a wide assortment of psychological wellness issues, for example, tension, stress, depression, and sleeping difficulties (Dunleavy, 2020; Galvin, 2020).

Coronavirus lockdown has influenced more than 860 million children and adolescents around the world. Also, lockdown and school closure may negatively affect children, influencing their social life, education, and psychological well-being. Even though the current school terminations contrast from summer holidays in that learning is relied upon to proceed carefully, the closures would probably broaden the gap between children from lower-pay and higher-pay families (Lancker and Parolin, 2020). The first case of Covid-19 in Nigeria was confirmed on February 27, 2020 (Ojewale, 2020), following which the Nigeria Centre for Disease Control (NCDC) gave several guidelines for curtailing the spread, following the internationally approved standard (Ojewale, 2020). These measures notwithstanding, the number of cases proceeded to rise and was assessed at 24,077 by June 27, 2020 (Ojewale, 2020). Already, by March 2020, the spread of the infection had driven the administrative and state governments and their different parastatals to close down exercises in the nation. By March 23, both land border and air space had been shut; week after week, the Government leader gathering meeting was suspended, among other measures

(Ojewale, 2020). On Monday, March 23 2020, the Nigerian Universities Commission (NUC) ordered all universities' lockdown and affiliated schools (Ojewale, 2020). The lockdown has prompted a stop in academic activities and students returning home or suspending their industrial training - an impromptu break.

Several researchers have carried out surveys to determine the prevalence of anxiety and depression during the lockdown, analyze the psychological effects of quarantine, determine post-traumatic stress after severe acute respiratory syndrome (SARS) epidemics, and also assess the impact of home quarantine on children's mental health (Cao et al., 2020; Mazza et al., 2020; Wang et al., 2020; Huckins et al., 2020; Orgilés et al., 2020; Golberstein et al., 2020; Sprang and Silman, 2013; Dunleavy, 2020; Galvin, 2020).

The social distancing and stay-at-home orders are given in urban areas across the globe lessen the opportunities for physical activities among children, especially for children in metropolitan territories living in small apartments. Separation and protection could bring about expanded inactive behaviors and food consumption, which would probably affect weight and subsequently well-being and sleep over the long run (Rundle et al., 2020; Becker and Gregory, 2020). During the pandemic, the prevalence of physically inactive students increased extensively from 21.3% to 65.6%. Generally speaking, screen time increased extensively during the pandemic, and screen time during relaxation was also prolonged, showing that nearly a quarter of students engaged in long screen time for recreation (Xie et al., 2020).

This present study, therefore, analyzes the impact of the COVID-19 lockdown on students' mental health in Gusau, one of the towns in Nigeria, through the investigation of how the students' psychology, behavior, and routine activities were affected by the introduction of lockdown protocols/policy during the COVID-19 pandemic crisis. The output obtained from this investigation would provide guidance and recommendations on how the government can best handle the second wave or future pandemic crisis that might arise (in the future) without affecting the students' psychology, behavior, and routine activities.

Research Questions

This research provided answers to the following research questions: (1) Were students' psychology, behavior, and routine activities affected by the lockdown protocol? (2) How significantly does it affect the students? (3) How do their gender, age, education level, and type of school attended by the students contribute to the change in their psychology, behavior, and routine activities?

Null Hypothesis

In assessing the effect of the lockdown protocol on students' psychology, behavior, and routine activities, the following hypothesis were proposed: (1) The students' psychology was significantly affected by the lockdown protocols, (2) The students' behavior was significantly affected by the lockdown protocols, (3) The students' routine activities were significantly affected by the lockdown protocols.

RESEARCH METHOD

Research Design and Analytical Method

A hybrid method that employs both descriptive and 4-by-2 full factorial design methods was employed in this study, where the data were analyzed using frequency counts, mean, percentage, f-test, and factorial design analysis. The full factorial design method (in Table 1) was used to identify all possible categories of respondents that this study would potentially have, using the 4 factors defined in the research questions as the biodata, which includes the students' gender, education, school-type attended, and age class. 16 categories of students were identified as possible, out of which categories of respondents not available were acknowledged as 'one with an uncertain view' that scores their effects on psychology, behavioral and routine activities change as 2 based on this study's scale. The response (i.e., output) variable was the psychology, behavioral, and routine activities changes recorded as the mean scores. Also, the factors were designed to be on two levels each.

Table 1. Factorial design parameters

Study Type	Factorial	Experiment	16	Center Points	0
Initial Design	2 Level Factorial	Blocks	No Blocks	Design Model	4FI
Response	Name	Obs	Minimum	Maximum	Trans Model
Y1	R.Change	16	1.6031746	2	None R3FI
Y2	B.Change	16	1.8888889	2.2798354	
Y3	P.Change	16	1.53125	2.125	
Factor	Name	Type	Low Actual	High Actual	
A	Gender	Categorical	FEM	MAL	Levels: 2
B	School-type	Categorical	PRV	PUB	Levels: 2
C	Age	Categorical	U18	G18	Levels: 2
D	Education	Categorical	SSC	HGH	Levels: 2

The hypotheses formulated were tested at 0.05 levels of significance using mean and ANOVA. In the test, when the 'mean is less than 2,' or 'prob>f value is less than 0.05', it implies hypothesis acceptance, while if otherwise, it would be rejected.

Research Location

The study area is Gusau, located in the Gusau Local Government Area of Zamfara State in the Northwestern region in Nigeria. The majority of the residents speak the Hausa language. The town lies between latitude 12.1628° N and longitude 6.6745° E with an area of 3,364km. The population of the town is 383,162 as of the 2006 census (Wikipedia, 2020). Gusau site just north of a line attracted from Kebbi to Kano, its populace is generally Hausa with certain Fulani, Yoruba, Igbo, Igala, and Nupe likewise lives there.

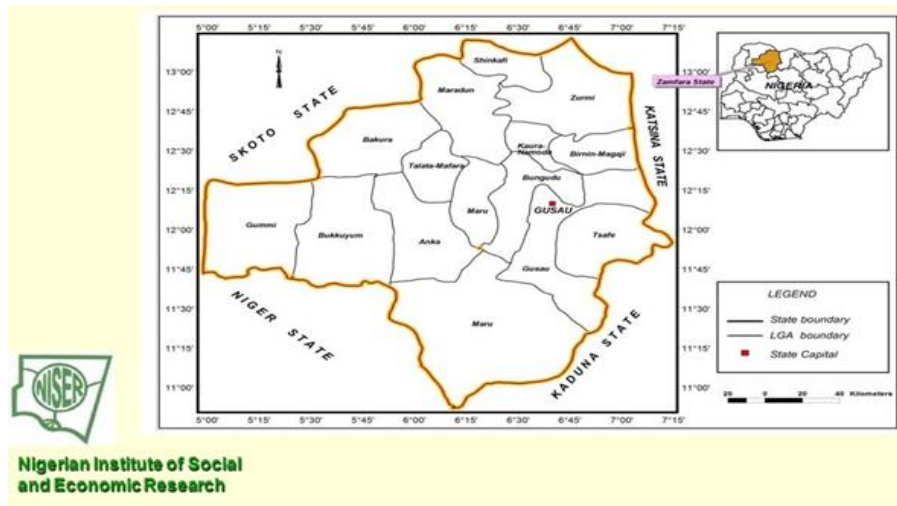


Fig. 1. Map showing the study area.

Data Collection and Research Instruments

A research instrument tagged "COVID-19 Lockdown Impact Assessment on Students' Psychological, Behavioral, and Daily Routine Changes: A Case Study of Gusau Residents Questionnaire" was used to collect data for the study. However, a hybrid approach of using a hard-copy and electronic questionnaires designed via Google Form was used to ease the data collection for this study to obtain the relevant data. The questionnaire contains information such as sex, age, educational background, psychological, behavioral, and routine activities change parameters, where the responses were rate on the scale of 1 to 3, where 1 stand for 'Affected', 2 stands for 'Not Certain of Whether Affected or Not', and 3 stands for 'Not affected'.

Study Population and Sample Size

The population comprises male and female residing in Gusau, Zamfara state, and the study area is about 383,162 people. This study enrolled 201 respondents in this survey ranging from below 18 years to above 18 of age.

Ethical Consideration

Individual consent was obtained from the respondent before completing the questionnaire. The respondents' right was protected by informing them about this study purpose and not forcing them to participate. Anonymity was ensured by the fact that identifying information about the individual subjects was not collected. All information was for research purposes only and kept confidential, not disclosing respondents' identity during and after the research.

RESULTS AND DISCUSSIONS

Socio-demographic characteristics of the respondents

The social-demographic characteristics of the students that gave responses are presented in Table 2. The results show the gender distribution; 201 students responded to the assessment, 104 (51.7%) were males, and 97 (48.3%) were females.

From the results collected for the students' age distribution presented in Table 2, about 139 (69.2%) of the respondents were less than 18 years (age) while 62 (30.8%) respondents were greater than 18 years (age). Most of the respondents, 136 (67.7%), went to primary/secondary only, while the remaining 65 (32.3%) had NCE/ND/HND/BSC/MS/PhD in Table 2. About 110 (54.7%) of the respondents attend a private school, while 91 (45.3%) of the respondents attend a public school (in Table 2).

Table 2. Socio-demographic characteristics of the students that responded.

Characteristics	Categories	Count	Percentage (%)
Gender	Male	104	51.7
	Female	97	48.3
Age	Less than 18 years	139	69.2
	Greater than 18 years	62	30.8
Educational background	Pri/Sec Education	136	67.7
	Tertiary Education	65	32.3
School type attended	Public School	91	45.3
	Private School	110	54.7

In general, it was deduced that the number of male students was more than the female respondents, two-third of the participating students were found to be under the age of 18, the students' attending private schools were found to be 5% above the number of those attending public schools. In regards to education, two-third of the students that participated in this study was identified to be attending lower/middle school.

Response analysis and the contribution of the social-demographic data on the students' routine activities, behavioral and psychological changes

(a) Evaluation of the null hypotheses for acceptance

The result collected for the assessment of the covid-19 impact on students' routine activities, behavioral changes, and psychological changes is presented in Table 3, where the unit effect scores (X) for the different categories of students' responses denoted the average scores for that class of students in each category alongside with the frequency (F) indicating the number of students present in each category. In contrast, the total effect score (FX) signifies the product of the unit effect score (X) and frequencies (F) for each category of students that participated in this study. The analysis measures the impact of the COVID-19 lockdown policy on the students' routine activities changes, behavioral changes, and psychological changes using the overall mean effect (AV), as shown in Table 3.

Analysis of the unit effect scores obtained for the different categories of students indicated that for the case of routine changes, all the categories of respondents that participated were affected, unlike the cases of behavioral and psychological changes, since the respective scores obtained for each category were found to be less than 2. This finding implies that all students' routine activities were affected while some students' behavior and psychology were not affected. The categories of students whose behavior did not experience any significant changes only include FEM-PUB-U18-SSC (16 respondents) and MAL-PRV-U18-SSC (54 respondents), those whose psychology was not affected only includes FEM-PUB-U18-

HGH (1 respondent) and MAL-PUB-HGH (31 respondents). Categories of those whose behavior and psychology were not affected were FEM-PRV-G18-HGH (3 respondents) since their unit effect scores were found to be greater than 2.

Table 3. Results for the effect of the lockdown protocol on students' routine activities, behavioral changes, and psychological changes

Factor				Unit Effect Score, X			No of Respt.	%	Total Effect Score, FX		
Gender	Sch type	Age	Educ	R	B	P	F	F	R	B	P
FEM	PRV	U18	SSC	1.64	1.87	1.80	50.00	24.88	82.00	93.50	90.00
FEM	PRV	G18	HGH	1.33	2.08	2.08	3.00	1.49	4.00	6.25	6.25
FEM	PUB	U18	SSC	1.58	2.02	1.61	16.00	7.96	25.25	32.25	25.75
FEM	PUB	U18	HGH	1.50	1.75	2.00	1.00	0.50	1.50	1.75	2.00
FEM	PUB	G18	HGH	1.53	1.76	1.95	27.00	13.43	41.25	47.50	52.75
MAL	PRV	U18	SSC	1.76	2.10	1.98	54.00	26.87	95.00	113.25	106.75
MAL	PRV	G18	HGH	1.58	1.75	1.92	3.00	1.49	4.75	5.25	5.75
MAL	PUB	U18	SSC	1.66	1.97	1.83	16.00	7.96	26.50	31.50	29.25
MAL	PUB	U18	HGH	1.75	1.88	2.25	2.00	1.00	3.50	3.75	4.50
MAL	PUB	G18	HGH	1.53	1.79	2.03	29.00	14.43	44.25	52.00	58.75
Total							201.00	100.00	328.00	387.00	381.75
Overall Average Effect, AV									1.63	1.93	1.90

(U18 is less than 18 years, G18 is greater than 18 years, FEM is female, MAL is male, PRV is a private school, PUB is a public school, SSC is primary to secondary school, while HGH is a higher institution).

Moreover, these results indicated that male students from a private school (including the female students attending public school) whose age were less than 18 years experienced no significant change in their behaviors, which could be attributed to the possible joy of being with their loved ones and parents, access to a virtual learning program from their schools (Seble and Worku, 2020) or private home classes organized by their parent as a way of keeping them busy, being an under-age student. For the psychological changes, the male students from public schools, who are in higher institutions, were not primarily affected, maybe because they are used to the consistent practice of shutting down high institutions in the countries typically caused by a labor union or higher institution union strikes which agrees with the report of the Wickens (2011) on the academic and psychological impact of labour union and strikes on university campuses and students (Wickens, 2020).

However, the overall average effect (AV) scores obtained for the students' routine changes, behavior and psychology were R=1.63, B=1.93, and P=1.90, respectively, as displayed in Table 3. In totality, the AV results were less than 2, which implies that the students' change in routine activities, behavior, and psychology were significantly affected overall. The significant impact recorded for the changes was found to agree with UNESCO's (2020) report, which indicated that students are negatively affected by the COVID-19 lockdown policy.

(b) Evaluation of the possible elements responsible for the null hypothesis results

Some of the possible factors resulting in the overall changes experiences or reported for Psychology (P), Behavioral (B), and Routine changes (R) in Table 3 earlier, for their overall average effect (AV) are presented in Table 4, where factor

displaying scores greater than 2 were categorized to be insignificant but if otherwise, were considered significant.

The results presented in Table 4 for the evaluation of the effect of COVID-19 lockdown policy on the student's psychology (P) indicates that "not having an interest in book reading" (mean=1.32), "afraid that their family members could fall ill with COVID-19" (mean=1.57), and "the students being significantly afraid of falling ill with COVID-19" (mean=1.87) were mostly responsible for the psychological changes experienced by the students and since most of the student stayed with their parent or family members during the lockdown, so staying alone is not part of the psychological effects that affect the students during the lockdown. The deduction that students are tired (or stressed), fear that loves ones might die, and many other worries were found to agree with the report of Sahu (2020), which reported that stress could lead to mental and physical health challenges (Sahu, 2020).

Table 4. The factors contributing to the changes in the students' routine activities, behavior, and psychology.

	Effect	P: Not having an interest in book reading	P: You were afraid of falling ill with COVID-19	P: You were afraid that your family members could fall ill with COVID-19	P: You stay alone during the lockdown
Mean	P	1.32	1.87	1.57	2.84
Variance	P	0.34	0.61	0.46	0.19
	Effect	B: Feeling afraid something terrible might happen	B: Worrying about things	B: You do get angry quickly than before during lockdown	B: You feel more tired than usual
Mean	B	2.03	2.04	1.81	1.82
Variance	B	0.36	0.46	0.46	0.52
	Effect	R: You were eating more than you used to do	R: You had difficulties in falling asleep	R: You were not able to hang out with your friends	R: Your school was not running the lockdown program
Mean	R	1.71	2.19	1.63	1.00
Variance	R	0.54	0.55	0.27	0.005

For behavioral changes reported, the overall effect on the student was found to be attributed mainly to the fact that most of the students unnecessarily gets angry quickly than before during lockdown (mean=1.81) and feels more tired than usual (mean=1.82), possibly mainly due to repeated unchanged cycle of lives that the students were living during the lockdown period. Other factors that recorded lower contribution to the change in the students' behavioral changes, including feeling afraid something terrible might happen and worrying about things, were found not to have significantly affected the students during the lockdown. However, some respondents reported being affected by both, as shown in Table 4.

For changes in routine activities presented in Table 4, some of the factors that significantly contributed to the students' changes include eating more than they used to do before the lockdown (mean=1.71). Another factor is that most of the students

could not hang out with their friends during lockdown (mean=1.63), and most of the schools were not running lockdown program, which significantly affects the students' changes in routine (mean=1.00). Difficulty in sleeping does not significantly contribute to the overall students' routine changes, although a few students reported having difficulties sleeping, as presented in Table 4. Concerning the factor affecting the obstruction of students' routine activities, Seble and Worku (2020) report that the COVID-19 lockdown policy further goes a long way to increase social inequality in our schools where students from a wealthy family are privileged to access schools with digital infrastructure where average Nigerian students could not. This must-have contributed to triggering the less privileged class to be angry always, which generally affected behavior and psychology.

Our results presented in Table 4 shows that respondents were more frightened about their family member falling ill with COVID-19 than themselves, which is similar to the result gotten by Segre et al. (Segre et al., 2020). Students significantly ate more during the lockdown, similar to some research already carried out (Segre et al., 2020; Briggs and Kattey, 2020).

Contribution of the social-demographic data on the students' routine activities, behavioral and psychological changes using Normal plot

A normal plot displaying the contribution of the main-factors (i.e., age, gender, school-type, and education-level) and factor-interactions on the students' route activities, behavioral and psychological change caused by the COVID-19 lockdown policy were presented in Figure 2 to 4 for the students' route activities, behavioral and psychological change, respectively. Factors found on the trendlines (factors that intersected with the trendline) were confirmed to have shown an insignificant effect on the route activities' change. Excluding the main-factors (A-D), factor-interactions that were found not to be significant for the case of the routine activities effect's normal plot (Figure 2) were AB, AC, AD, ABD, and ACD while others like BC, BD, CD, ABC, BCD, and ABCD were found to be significant. For the behavioral effect normal plot (Figure 3), the factor-interactions that were significant include AB, AC, AD, BD, CD, ABC, ABD, and ACD, while BC, BCD and ABCD were not significant.

As for the contribution of age, gender, school-type, and education-level in affecting the students' psychology, AB, AC, AD, BD, CD, ABD, and BCD were the significant factor-interactions while the insignificant interactions that have insignificant influence on the effect includes BC, ABC, ACD, and ABCD as shown in the normal plot (Figure 4).

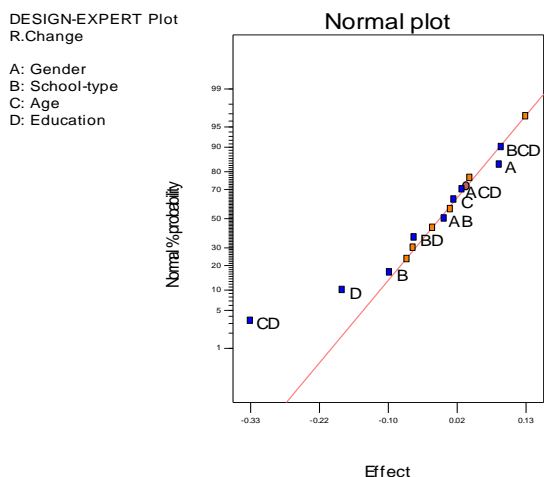


Fig 2. Contribution of age, gender, school-type, and education-level in affecting the students' routine activities.

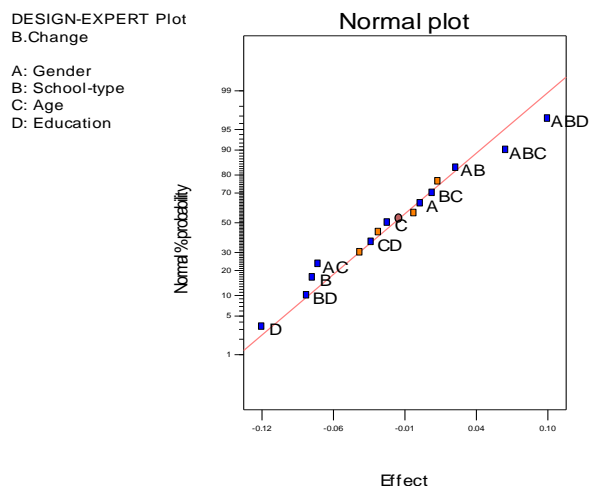


Fig 3. Contribution of age, gender, school-type, and education-level in affecting the students' behavior.

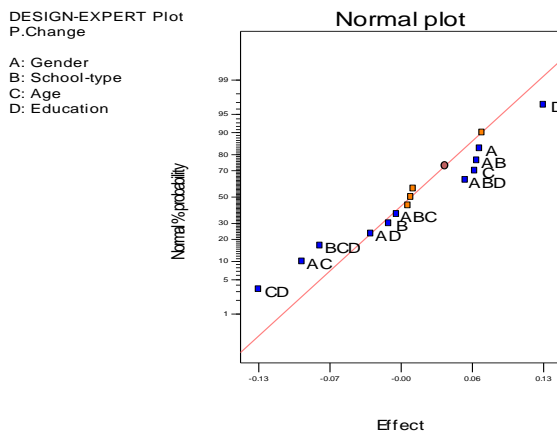


Fig 4. Contribution of age, gender, school-type, and education-level in affecting the students' psychology.

However, the factor-interaction with the highest contribution was CD, ABD, and AC for routine activities and behavioral and psychological effects, respectively, while the main-factor with the highest contribution was D (i.e., education). As mentioned earlier, the factors were confirmed to be of higher contribution due to their widespread away from the trendlines in Figures 2-4 for the normal plots.

Factorial model for the response predictions of COVID-19 impact on students

The normal plot analysis outcome was employed to eliminate insignificant terms for the respective models for the routine activities, behavioral and psychological changes prediction. With the use of the factorial analysis, a prediction model for the routine activities (Equation 1), behavioral (Equation 2), and

psychological (Equation 3) effects caused by the COVID-19 lockdown policy in Nigeria, specifically in Gusau LGA, are presented in Equation 1-3.

$$R.Change = 1.740871 + 0.043467*A - 0.04862*B + 0.005417*C - 0.08833*D + 0.065741*A*B - 0.02801*B*D - 0.16538*A*D - 0.0288*A*B*C + 0.045131*B*C*D - 0.03394*A*B*C*D \quad Eq(1)$$

$$B.Change = 1.935143 + 0.000366*A - 0.03993*B - 0.01193*C - 0.05881*D + 0.01363*A*B - 0.0378*A*C - 0.02218*A*D - 0.04207*B*D - 0.01798*C*D + 0.032267*A*B*C + 0.047892*A*B*D - 0.01526*A*C*D \quad Eq(2)$$

$$P.Change = 1.965245 + 0.034443*A - 0.00686*B + 0.032201*C + 0.063451*D + 0.03317*A*B - 0.04626*A*C - 0.01501*A*D + 0.035557*B*D - 0.06601*C*D + 0.027933*A*B*D - 0.03811*B*C*D \quad Eq(3)$$

Where A is students' gender, B is the student category of the school attended, C is the student's age class, and D is the level of his/her current education/study. All the variables/factors are categorized not numeric, i.e., A (FEM/MAL), B (PRV/PUB), C (U18/G18), and D (SSC/HGH). The analysis of the main-factor terms involved in the models indicated that A (gender, i.e., from FEM to MAL) positively and B (school-type, i.e., PRV to PUB) negatively affect the R-change, B-change, and P-change; while C (Age, i.e., U18 to G18) positively affect R-change and P-change but negatively affect B-change. D (Education-level, i.e., from SSC to HGH) negatively affect R-change and B-change but positively affect P-change.

Factorial analysis of the social-demographic characteristics with the changes in R, B, and P responses

(a) Descriptive statistics for the prediction model analysis

The results presented in Table 5 show the descriptive statistics for the prediction model accuracy analysis, where the R is the routine activities, B is behavioral changes, and P is the psychological changes.

Table 5. Descriptive statistics for the prediction model accuracy analysis

Criteria	R	B	P
Std. Dev.	0.05	0.02	0.01
Mean	1.74	1.94	1.97
C.V.	2.66	1.04	0.67
PRESS	0.11	0.03	0.01
R-Squared	0.99	0.99	1.00
Adj R-Squared	0.96	0.97	0.99
Pred R-Squared	0.86	0.84	0.96
Adeq Precision	18.13	19.47	55.54

Sources: own study, Alpha at 0.05 level of significance

The results obtained show that 99% variation of change in students' routine and behavior during COVID-19 lockdown can be explained by age, gender, school type, and educational qualifications. In comparison, 100% variation of students' psychological changes during COVID-19 lockdown can be explained by age, gender, school type, and educational qualifications.

(b) Analysis of variance for the routine activities effect prediction model

Looking at the variance analysis (ANOVA) for the change in routine activities model in Table 6, the first step after determining the model vector is to estimate the

statistical significance of model coefficients. P-value determines the significance or insignificance of each coefficient. P-values lower than 5% indicates that the coefficient of a model term is significant. Based on the P-values, the first order effects of variables gender, school type, and educational level (A, B, and D) with a p-value of 0.0133, 0.0085, and 0.0006 were less than 0.05, the interactions effect of school type and age (BC), age and educational level (CD), school type, age and educational level (BCD), and gender, school type, age and educational level (ABCD) with a p-value of 0.0024, 0.0001, 0.0115 and 0.0326 are less than 0.05 respectively in line with the literature (Charles et al., 2017; Douglas, 2017).

Table 6. Analysis of variance (ANOVA) for the R model and the factors involved

Source	Sum of Squares	DF	Mean Square	F Value	Prob > F
Model	0.776958	10	0.077696	36.19223	0.0005
A	0.03023	1	0.03023	14.08162	0.0133
B	0.037822	1	0.037822	17.61804	0.0085
C	0.00047	1	0.00047	0.218705	0.6597
D	0.124843	1	0.124843	58.15452	0.0006
BC	0.06915	1	0.06915	32.21154	0.0024
BD	0.012552	1	0.012552	5.846959	0.0603
CD	0.437602	1	0.437602	203.8435	< 0.0001
ABC	0.01327	1	0.01327	6.181412	0.0554
BCD	0.032588	1	0.032588	15.18025	0.0115
ABCD	0.018431	1	0.018431	8.585731	0.0326
Residual	0.010734	5	0.002147		
Cor Total	0.787692	15			

Key: A= Gender, B= School type, C= Age, and D=Educational Level
 Sources: own study, Alpha at 0.05 level of significance

Other model terms that are not significant (with probability values larger than 0.05) are age (C), the interaction between BD (school type and educational level), ABC (gender, school type, and age). The result obtained in Table 6 shows that the student's gender, school type, and educational level significantly affected the change of students' daily routine activities during COVID-19 lockdown.

(c) Analysis of variance for the behavioral change effect prediction model

Table 7 presents the analysis of Variance (ANOVA) for the Behavioral changes model and the factors involved. The P-values show that school type and educational level (B and D) with p-values of 0.0041 and 0.0013 significantly affected students' behavior during COVID-19 lockdown.

Table 7. Analysis of variance (ANOVA) for the B (Behavioral changes) model and the factors involved.

Source	Sum of Squares	DF	Mean Square	F Value	Prob > F
Model	0.207397	12	0.017283	43.00529	0.0051
A	2.14E-06	1	2.14E-06	0.005337	0.9464
B	0.025506	1	0.025506	63.46514	0.0041
C	0.002278	1	0.002278	5.66759	0.0976
D	0.055331	1	0.055331	137.6795	0.0013

AB	0.002972	1	0.002972	7.396292	0.0726
AC	0.022864	1	0.022864	56.89275	0.0048
AD	0.007869	1	0.007869	19.58111	0.0214
BD	0.028318	1	0.028318	70.46453	0.0035
CD	0.005173	1	0.005173	12.87304	0.0371
ABC	0.016659	1	0.016659	41.45176	0.0076
ABD	0.036699	1	0.036699	91.3167	0.0024
ACD	0.003725	1	0.003725	9.269704	0.0557
Residual	0.001206	3	0.000402		
Cor Total	0.208602	15			

Key: A= Gender, B= School type, C= Age, and D=Educational Level

Sources: own study, Alpha at 0.05 level of significance

According to the literature (Charles et al., 2017; Douglas, 2017), the effect of the interactions of gender and age (AC), gender and educational qualification (AD), school type and educational qualification (BD), age, and educational level (CD), gender, school type and age (ABC), and gender, school type and education level (ABD) with a p-value less than 0.05 had a significant effect of behavioral change during COVID-19 lockdown. Other model terms that are not significant (with probability values larger than 0.05) are gender (A), age (C), the interaction between gender and school type (AB), gender age, and educational qualification (ACD).

(d) Analysis of variance for the psychological change effect prediction model

Table 8 presents the Analysis of Variance (ANOVA) for the Psychological changes model and the factors involved. Based on the P-values, it is shown that gender, age, and educational level (A, C, and D) with a p-value of 0.0005, 0.0006, and 0.0001 had a significant psychological effect changes on students during COVID-19 lockdown.

Table 8. Analysis of variance (ANOVA) for the P model and the factors involved.

Source	Sum of Squares	DF	Mean Square	F Value	Prob > F
Model	0.281844	11	0.025622	147.4544	0.0001
A	0.018982	1	0.018982	109.2376	0.0005
B	0.000753	1	0.000753	4.33527	0.1058
C	0.01659	1	0.01659	95.47657	0.0006
D	0.064416	1	0.064416	370.7121	< 0.0001
AB	0.017604	1	0.017604	101.3113	0.0005
AC	0.034235	1	0.034235	197.0218	0.0001
AD	0.003603	1	0.003603	20.73685	0.0104
BD	0.020229	1	0.020229	116.4181	0.0004
CD	0.069707	1	0.069707	401.1596	< 0.0001
ABD	0.012484	1	0.012484	71.84468	0.0011
BCD	0.02324	1	0.02324	133.7447	0.0003
Residual	0.000695	4	0.000174		
Cor Total	0.282539	15			

Key: A= Gender, B= School type, C= Age, and D=Educational Level

Sources: own study, Alpha at 0.05 level of significance

In term of interactions, the effect of the interactions of gender and school type (AB), gender and age (AC), gender and educational qualification (AD), school type and educational level (BD), age and educational qualification (CD), gender,

school type and educational qualification (ABD), and school-type, age and education-level (BCD) with a p-value less than 0.05 had the significant effect of psychological changes during COVID-19 lockdown. The result shows that school type had no significant effect on psychological changes during COVID-19 lockdown, following the literature (Charles et al., 2017; Douglas, 2017).

Contribution of the social-demographic characteristics (main-factors and factor-interaction) on the change in the students' psychology, behavior, and routine activities

The effect of the main factors (i.e., the students' social-demographic characteristics) and the factor-interactions was presented here using Figure 5 (a-d) and Figure 6 (a-c).

(a) Main-factors effects

Considering one factor effects, i.e., age, gender, school-type, or education background on students' routine activities, behavioral, or psychology changes in Figure 5(a-d).

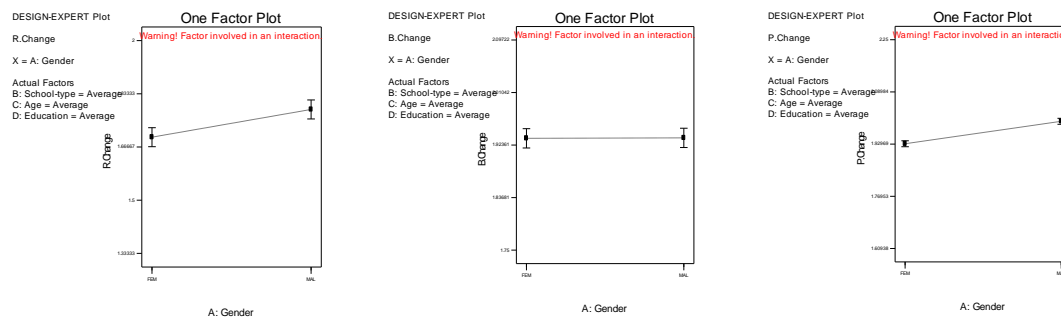


Fig. 5a. Effect of gender on the students' psychology, behavior, and routine activities changes

Figure 5a indicated that female respondents were mostly affected psychologically and in routine activities changes than the male respondents and statistically significant (Table 8). In contrast, the behavioral changes are equally in both males and females, though not statistically significant in agreement with the ANOVA result earlier presented in Table 7. The result gotten in Figure 10a could occur since adult females and even children (female) provide unpaid care in families in Nigeria, ranging from cooking, washing, taking care of kids, and general house cleaning. Because of the lockdown, stay-at-home order of the Federal Government, most female household chores have been multiplied or significantly increased by and large, and this can be distressing, resulting in a higher experience of psychological distress. Women in eight nations across Africa (Nigeria excluded) and Asia were reported to have consistently self-reported more severe sleep problems than men based on series of roles they play in families (Stranges et al., 2012), female more than their male counterpart were affirmed to be vulnerable to insomnia (Zhang and Wing, 2006) and high post-traumatic

Concerning the students' school type (in Figure 10b), respondents in public institutions were more affected in routine activities changes and behaviorally than the private school respondents and statistically significant. In the psychological aspect, students in public institutions were still more affected than students in private institutions, though slightly and not statistically significant in agreement with the ANOVA result earlier presented in Table 8. Figure 5b shows that students in public institutions were significantly affected behaviorally and in routine activities changes than students in private institutions, which was similar to the research conducted by Segre *et al.* (Segre *et al.*, 2020).

stress manifestations (Liu *et al.*, 2020).

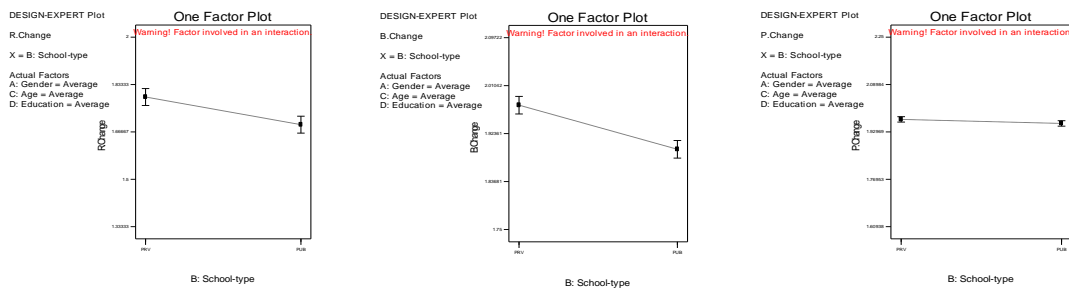


Fig. 5b. Effect of school-type in affecting the students' psychology, behavior, and routine activities changes

According to the results presented in Figure 5c concerning the student's age, it was deduced that students who were below 18 years of age were slightly affected in routine activities change though not statistically significant (in agreement with ANOVA result earlier presented in Table 6) and psychologically than students who were older than 18 years of age, although statistically significant (in Table 8) in the psychological change. In contrast, students who were above 18 years of age were slightly affected behaviorally more than students who were lesser than 18 years of age, though not statistically significant (as presented in Table 8).

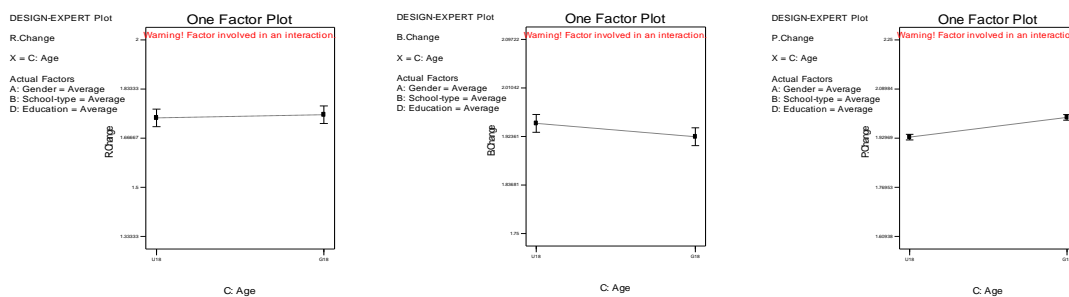


Fig. 5c. Effect of age in affecting the students' psychology, behavior, and routine activities changes

The result gotten in Figure 5c could be due to the assumption that younger students have more fear than older students. A study conducted showed that in young children and adolescents, the pandemic and lockdown have a higher impact on emotional and social development than the grown-ups. In one of the preliminary studies during the on-going pandemic, it was discovered that younger children (3-

6years old) were more likely to manifest symptoms of clinginess and the fear of family members being infected than older children (6-18 years old). Although, severe psychological conditions of increased irritability, inattention, and clinging behavior were revealed by all children irrespective of their age groups (Viner et al., 2020). Findings reveal that children felt uncertain, fearful, and isolated during current times. It was also shown that children experienced disturbed sleep, nightmares, agitation, inattention, and separation-related anxiety (Jiao et al., 2020).

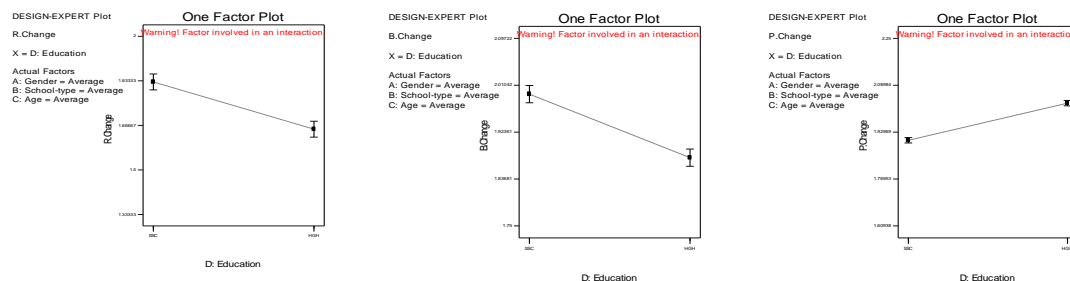


Fig. 5d. Effect of education-level in affecting the students' psychology, behavior, and routine activities changes

Moreover, in the study of the influence of the student's education-level (Figure 5d), i.e., the students' education background, it was identified that students of higher institutions were primarily affected in routine activities changes and behaviorally than students in primary to secondary schools and statistically significant. In contrast, secondary school students were more affected psychologically than students in higher institutions and statistically significant. These deductions were found to have shown a good relationship with what was obtained for the ANOVA result earlier presented in Table 6-8.

The result in Figure 10d indicates that higher institutions get angrier than before the lockdown, which is due to the restriction of movement and inability to hang out with friends during the lockdown. A study found that youth are anxious regarding the cancellation of examinations, exchange programs, and academic events (Lee, 2020). In contrast, secondary school students were more significantly affected psychologically, which indicates that students in secondary schools are more likely not to have an interest in book reading than students in higher institutions.

(b) Factor-interactions effects

The effect of three-factors interactions in affecting the students' routine activities, behavior, and psychology was presented in Figure 6.

(i) Effect of three-factors interactions in affecting the students' routine activities

ABC factor-interaction was earlier confirmed from the normal plot, and ANOVA results in Table 6 to be a significant term contributing to the change in the students' routine activities like the BCD. Results presented in Figure 6a shows the mode of the effect that ABC and BCD term resulted in the students' routine.

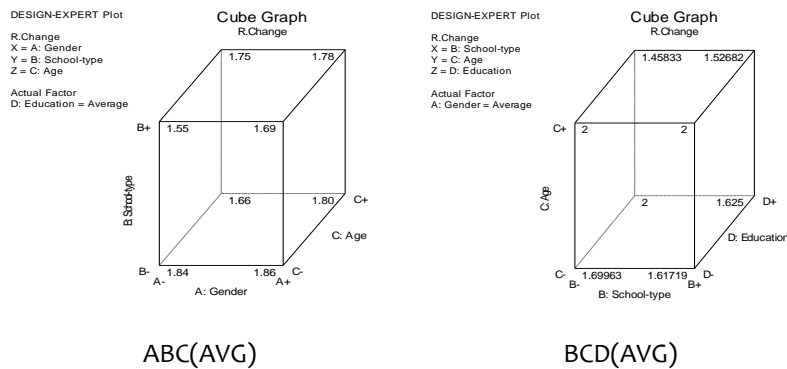


Fig. 6a. Effect of three-factors interactions in affecting the students' routine changes. (Where SSC=secondary school, HGH=higher institutions, FEM=female, MAL=male, G18=age greater than 18, U18=age under 18, PRV=private institution, PUB=public institution).

From which it was deduced that all the categories of students were primarily affected in ABC factor-interaction since the cube edge points were all less than 2, while the BCD factor-interaction cube shows that all the categories were all affected except some categories of students that show the uncertainty of being affected or not, which entails G18-PRV-SSC (B-,C+,D-); PRV-G18-HGH (B-,C-,D+) and PUB-U18-SSC (B+,C+,D-) since their score was equal to 2. Findings from the analysis indicated that all the students' routine activities who participated were confirmed to have been affected (Fig 6a).

(ii) Effect of three-factors interactions in affecting the students' behavior

In studying the behavioral changes observed for the students during the lockdown, ABC, ABD, and ACD factor-interaction (3-factors interaction) were confirmed from the normal plot and ANOVA results (in Table 7) to have significantly affected the students' behavior during the period. The results presented detailed information on how these factor-interactions affected the students' behavior is presented in Figure 6b.

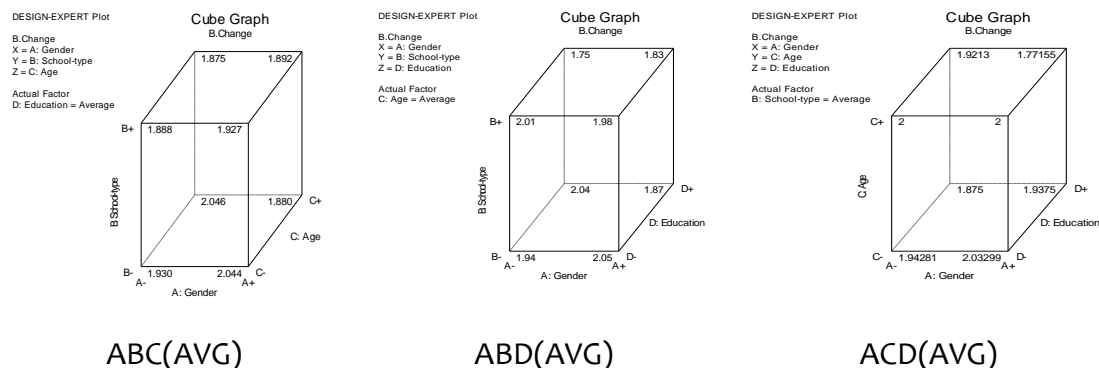


Fig. 6b. Effect of three-factors interactions in affecting the students' behavior. (Where SSC=secondary school, HGH=higher institutions, FEM=female, MAL=male, G18=age greater than 18, U18=age under 18, PRV=private institution, PUB=public institution).

A study of the result in the cube plot (in Figure 6b for ABC, ABD, and ACD) evaluating the effect on the different characteristics of students involved in the

analysis unveils that all categories of students involved in the study were affected (since their score were less than 2) except for FEM-PRV-G18 (A-,B-,C+) and MAL-PRV-U18 (A+,B-,C-). for ABC; FEM-PRV-HGH (A-,B-,D+), MAL-PRV-SSC (A+,B-,D-),and FEM-PUB-SSC (A-,B+,D-) for ABD; and MAL-U18-HGH (A+,C-,D-) for ACD, who were not affected (due to their score that was greater than 2), while FEM-G18-SSC (A-,C+,D-) and MAL-G18-SSC (A+,C+,D-) for ACD displayed an uncertainty effect on the cube plot in Figure 6b since their score is equivalent to 2.

(iii) Effect of three-factors interactions in affecting the students' psychology

ABD and BCD factor-interaction was the set of 3-factors interactions that have significantly resulted in a change in the students' psychology. Figure 6c diagrammatically presented a cube plot of how these factor-interactions influence their psychological changes by assessing changes observed for a category of students represented as an edge of the cube plot.

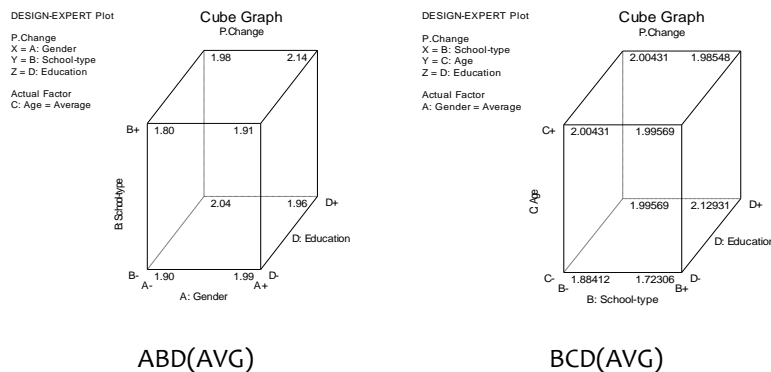


Fig. 6c. Effect of three-factors interactions in affecting the students' psychology. (Where SSC=secondary school, HGH=higher institutions, FEM=female, MAL=male, G18=age greater than 18, U18=age under 18, PRV=private institution, PUB=public institution).

From which, it was deduced that only students with characteristics FEM-PRV-HGH(A-,B-,D+), MAL-PUB-HGH(A+,B+,D+), PRV-G18-SSC(B-,C+,D-), PUB-U18-HGH(B+,C-,D+), and PRV-G18-HGH(B-,C+,D+) were not affected psychologically, all other categories of students were primarily affected. The students of private institutions (i.e., PRV-G18-SSC, FEM-PRV-HGH, and PRV-G18-HGH) not affected could be due to the online courses ran in their institution, which also keep them connected to their classmates and tutors. Other students of high public institutions with characteristics MAL-PUB-HGH and PUB-U18-HGH not affected could have enrolled themselves in some trade work, and skill acquisition programs virtually ran.

In a nutshell, the category of students who are female attending public higher institutions (A-,B+,D+) showed the lowest effect as 1.75, indicating the most affected class of students in terms of behavioral change while underage students (with age below 18 years) attending public lower/mid institution (i.e., primary/secondary schools) were found to be primarily affected psychologically compared to other class of students due to the 1.7231 record as lowest effect score obtained for their class (B+, C-, D-) in this analysis. In terms of routine activities change, adult students of

private higher institutions (B-, C+, D+) scored 1.4583, confirming the class to be the most primarily affected class of students in terms of an alteration of students' routine activities enjoyed in the non-pandemic era.

CONCLUSIONS

The impact of the COVID-19 lockdown on students' mental health in Gusau, one of the towns in Nigeria, through the investigation of how the students' psychology, behavior, and routine activities were affected by the Government lockdown policy during the COVID-19 pandemic crisis was successfully studied via the combined use of descriptive and factorial design analysis techniques. The study confirmed that the students' psychology was significantly affected by the lockdown protocols, likewise their behavior and routine activities. Some of the indicating factors that contributed to the change in the psychology difference were “lack of interest in study their books as usual”, “scare of being affected by the COVID-19” and “fear that some of their siblings might be or might have been affected (without test yet)”.

For the behavioral changes, 'getting angry easily' and 'experiencing tiredness more than usual (which could be due to the nature of life routine cycled over time)' were identified as the key contributing factors to the students' change behavior during the pandemic lockdown. Whereas 'appetite to eat more than usual even when available food is limited,' 'missing the opportunity of hanging with friends' and 'schools that are not running virtual program (as well as struggling with an unusual mode of learning)' were found to be some of the key indications that the students' routines were primarily affected.

In assessing how their gender, age, education level, and type of school attended by the students contribute to the change in their routine activities, the students' gender class, school-type, and education class significantly contributed to changes observed in their routine activities' alteration. In contrast, the students' age class displayed no significant contribution to the students' routine activities' changes, based on the ANOVA results. Moreover, the students' school-type insignificantly contributed to psychological changes based on the ANOVA results while other factors, like the students' age class, education class, and students' gender, were deduced to have significantly affected contributed to psychological changes. Also, the investigation of gender, age, education level, and type of school attended by the students' impact on the change in their behavior showed that the students' school-type and education-level/background significantly contributed to the behavior changes observed for the students while the students' gender and age insignificantly affected their behavior, based on the ANOVA results.

RECOMMENDATIONS

Therefore, the study recommends introducing virtual learning across all levels of education across the states, which is to be used both during a pandemic and post-pandemic areas, which would transform our learning system into a hybrid system that would combine the use of both physical and virtual class. This would go a long way to keep the school program organized and undistorted irrespective of the situation, especially in social distancing and restrictions policy. So, students' routine

activities, behavior, and psychology would no longer be significantly affected during the pandemic/crisis-era since it would not prolong their graduation and retain the students' appetite for learning. And governments of developing nations can support their institutions with virtually learning infrastructures for virtual/online classes, and all broadcasting stations can be obligated to dedicate 1-2 hours of the daily schedules for school teaching programs.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORS CONTRIBUTIONS

T. Oyegoke: Project Administration/Coordination, Conceptualization, Methodology, Software, Validation, Resources, Data/Formal Analysis, Data Interpretation, Writing (Original draft preparation, reviewing & editing), Visualization,

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A. O. Bamigbala – Validation, Statistics/Data Interpretation, Writing (Original draft preparation), Visualization.

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COVID-19 LOCKDOWN POLICY IMPACT ON STUDENTS' PSYCHOLOGICAL, BEHAVIOURAL AND DAILY ROUTINE CHANGES: A CASE STUDY OF GUSAU RESIDENTS IN NIGERIA

(SUPPLEMENTARY INFORMATION)

Table A1. Factorial design matrix cases and response' scores from the respondents

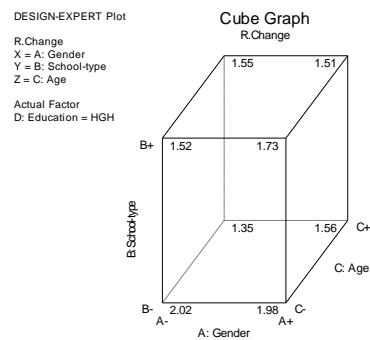
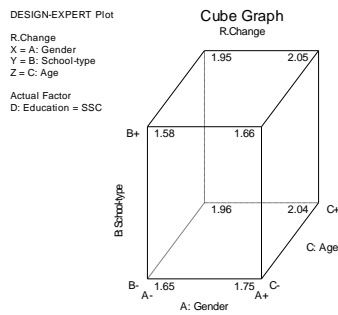
Gender	Type of School Attended	Age	Education	R-AVG2	B-AVG2	P-AVG2
FEM	PRV	U18	SSC	1.64	1.87	1.80
FEM	PRV	U18	HGH	2.00	2.00	2.00
FEM	PRV	G18	SSC	2.00	2.00	2.00
FEM	PRV	G18	HGH	1.33	2.08	2.08
FEM	PUB	U18	SSC	1.58	2.02	1.61
FEM	PUB	U18	HGH	1.50	1.75	2.00
FEM	PUB	G18	SSC	2.00	2.00	2.00
FEM	PUB	G18	HGH	1.53	1.76	1.95
MAL	PRV	U18	SSC	1.76	2.10	1.98
MAL	PRV	U18	HGH	2.00	2.00	2.00
MAL	PRV	G18	SSC	2.00	2.00	2.00
MAL	PRV	G18	HGH	1.58	1.75	1.92
MAL	PUB	U18	SSC	1.66	1.97	1.83
MAL	PUB	U18	HGH	1.75	1.88	2.25
MAL	PUB	G18	SSC	2.00	2.00	2.00
MAL	PUB	G18	HGH	1.53	1.79	2.03

Table A2. Questionnaire for covid-19 lockdown impact assessment on students' psychological, behavioral and daily routine changes: a case study of Gusau residents

BIODATA				
Gender	Male	Female		
Type of School Attended	Private	Public		
Age	Less than 18 Yrs	Greater than 18 Years		
Education	PRI.CERT/SSCE	NCE/ND/HND/ BSC/MSC/PHD		
PSYCHOLOGICAL CHANGES				
Not having an interest in book reading	Affected (1)	Not-sure (2)	Not	Affected (3)
You were afraid of falling ill with COVID-19	Affected (1)	Not-sure (2)	Not	Affected (3)
You were afraid that your family members could fall ill with COVID-19	Affected (1)	Not-sure (2)	Not	Affected (3)
You stay alone during the lockdown	Affected (1)	Not-sure (2)	Not	Affected (3)
BEHAVIOURAL CHANGES				
Feeling afraid something terrible might happen	Affected (1)	Not-sure (2)	Not	Affected (3)

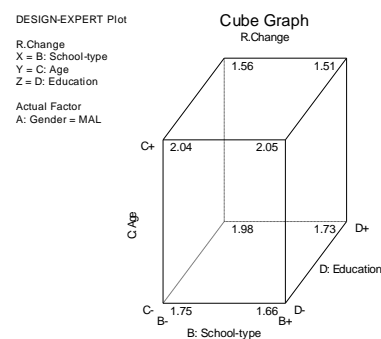
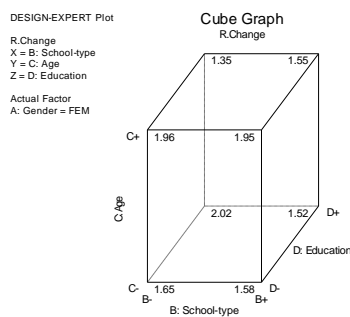
Worrying about things	Affected (1)	Not-sure (2)	Not Affected (3)
You do get angry quickly than before during lockdown	Affected (1)	Not-sure (2)	Not Affected (3)
You feel more tired than usual	Affected (1)	Not-sure (2)	Not Affected (3)
CHANGES IN ROUTINE			
You were eating more than you used to do	Affected (1)	Not-sure (2)	Not Affected (3)
You had difficulties in falling asleep	Affected (1)	Not-sure (2)	Not Affected (3)
You were not able to hangout with your friends	Affected (1)	Not-sure (2)	Not Affected (3)
Your school was not running the lockdown program	Affected (1)	Not-sure (2)	Not Affected (3)

Table A3. Routine activities



ABC(SSC)

ABC(HGH)



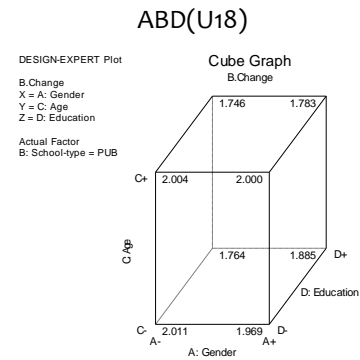
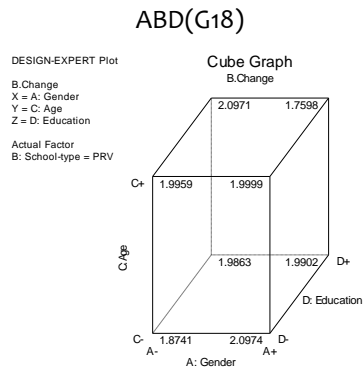
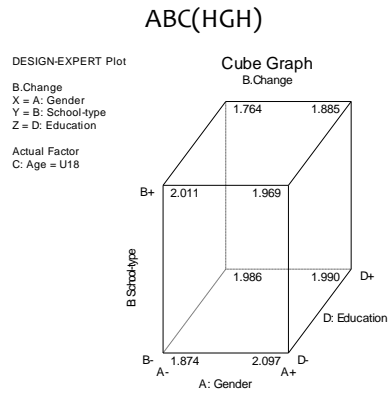
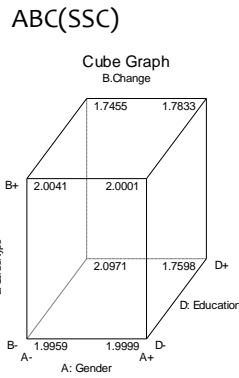
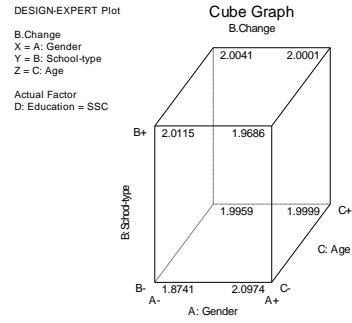
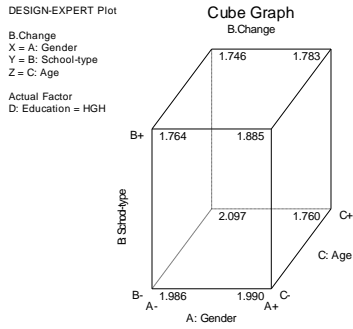
ABC(FEM)

ABC(MAL)

BCD(FEM)

BCD(MAL)

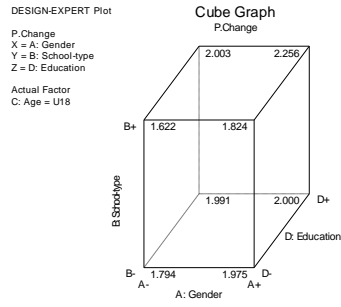
Table A4. Behavioral Effect



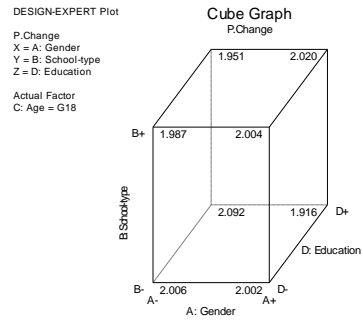
ACD(PRV)

ACD(PUB)

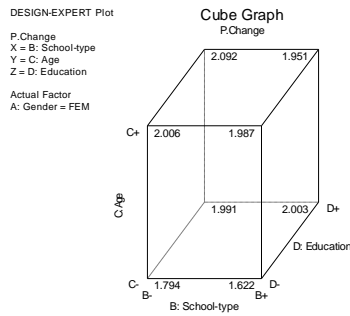
Table A5. Psychological Effect



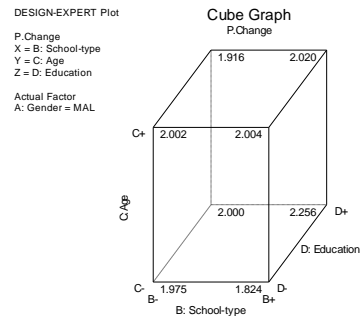
ABD(U18)



ABD(G18)



BCD(FEM)



BCD(MAL)

Table A6. Responses of respondents

PSYCHOLOGICAL CHANGES	Responses		
	Affected (1)	Not-sure (2)	Not affected (3)
Questions			
Not having an interest in book reading	149	40	12
You were afraid of falling ill with COVID-19	77	74	50
You were afraid that your family members could fall ill with COVID-19	107	73	21
You stay alone during the lockdown	5	24	172
BEHAVIOURAL CHANGES			
Questions			
Feeling afraid something terrible might happen	34	128	39
Worrying about things	43	109	49
You do get angry quickly than before during lockdown	69	100	32
You feel more tired than usual	74	90	37
CHANGES IN ROUTINE			
Questions			
You were eating more than you used to do	93	75	33
You had difficulties in falling asleep	41	83	77
You were not able to hangout with your friends	79	119	3