

Virtual learning environment factors as predictors of students' learning satisfaction during COVID-19 period in Nigeria

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Abstract

Purpose – The onus of this study was to find out the role played by virtual learning environment factors on students' satisfaction during the COVID-19 period in Nigeria. A survey was carried out on students in higher education institutions in Nigeria to actualize this purpose.

Design/methodology/approach – Simple random sampling techniques with the aid of Krejcie and Morgan's (1970) sample determinant and the Snowball sampling technique were adopted to sample 270 students in higher education institutions in Nigeria. An adapted questionnaire was used. Cronbach alpha coefficients were calculated for the two sections of the independent and dependent variables. Virtual learning environment factors yielded 0.89, while students' satisfaction yielded 0.87. Data were analyzed using descriptive statistics, Pearson product-moment correlation, two-way ANOVA and linear regression analysis.

Findings – The results of the ANOVA, $F(df\ 4, 265) = 50.905, p < 0.000$, indicate a statistically significant relationship (stronger than 0.05) between the independent variables (virtual learning environment factors) and the dependent variable (students' satisfaction). It was found among others that instructors' support and collaboration factors predicted students' satisfaction with virtual learning experiences during the COVID-19 period.

Originality/value – Virtual learning during COVID-19 caught both lecturers and students unprepared. Most developing countries especially Africans were used to the traditional face-to-face learning, more so, the use of virtual means to learn was still at a nascent stage. This study, therefore, contributed to the role of the learning environment in virtual learning satisfaction.

Keywords Virtual learning, Collaborative learning, Learning environment, Online learning

Paper type Research paper

1. Introduction

The incidence of the COVID-19 pandemic came as a rude shock to the whole universe. It became a serious issue among every living soul throughout the world. The World Health Organization (WHO) declared COVID-19 a pandemic in the year 2020 (Hamdan *et al.*, 2021; Hettiarachchi *et al.*, 2021; Kaur *et al.*, 2020). This has therefore affected all human endeavors, especially teaching and learning activities. All over the world, the trial of this pandemic has added great stress to human beings (Yekefallah *et al.*, 2021). Teachers and students got



automatic stay-at-home orders with the aim to curb and manage the spread of the virus. For months in some places in Nigeria, teaching and learning activities were in disarray at all levels of education: primary, secondary and higher.

To abate this unpleasant incidence, the federal government set up a presidential task force on the COVID-19 pandemic. The Task Force Committee in collaboration with the Ministry of Education and all other education stakeholders (parents, students, heads of schools and teachers) instructed schools at all levels of education in Nigeria to shut down the traditional face-to-face learning on March 9, 2020 (About the Presidential Task Force [PTF], 2021). The last resort to continue teaching and learning activities was to go for the option of virtual learning at all education levels.

Virtual learning has been christened with varieties of names among which are online learning (Shahzad *et al.*, 2020), distance learning, e-learning (Harsasi and Sutawijaya, 2018) and remote learning (The Albert Team, 2022). The belief is that online/virtual learning should ameliorate some of the difficulties posed by the COVID-19 pandemic to the teaching and learning process. This medium of learning was favored because it does not require physical contact. It provides teachers and students the opportunity to achieve what traditional face-to-face teaching and learning mode does. According to Hettiarachchi *et al.* (2021), virtual learning is the only medium in the contemporary world where seclusion is prioritized over socialization. It guarantees uninterrupted teaching and learning activities as well as guards against the spread of the disease. To achieve this and answer the yearnings of parents and students in this contemporary world that is full of fear, virtual learning becomes indispensable. Also, parents and students were curious to see the continuity of learning activities. Virtual learning can sustain learning activities because it allows learners to engage in learning anytime and anywhere (Robinson and Hullinger, 2008). In the review carried out by Johnston *et al.* (2005), it was reported that face-to-face learning does not have superiority over virtual learning, in terms of quality and learners' performance. They found that students' characteristics, the flexibility of the program and not being tied to a specific space influenced their satisfaction in virtual learning.

Nevertheless, Johnston *et al.* (2005) suggested that it must be well planned like other modes of instruction for the goals of education not to be jettisoned. Planning is crucial because the program transcends the mere completion of courses. It rather emphasizes that communicating with students promotes and improves their self-confidence during any emergency like the COVID-19 pandemic (Kaur *et al.*, 2020). Their evidence indicates that even before the outbreak of this pandemic disease, there was high growth in the adoption of educational technology. Evidence shows that the global EdTech investment amounting to US\$18.66bn (Li and Lalani, 2020) was invested into the provision of virtual learning before the outbreak of the COVID-19.

At this junction, it is important to reiterate that the role played by students' satisfaction in achieving the goal of teaching and learning online cannot be overemphasized. Learning may not take place unless the student's maturity, interest and readiness are guaranteed. Ali and Ahmad (2011) aver that students' learning satisfaction is a yardstick to measure the effectiveness of virtual learning.

Harsasi and Sutawijaya (2018) also report that students' satisfaction with virtual learning depends on the quality of online learning which will have an impact on learners' academic performance.

1.1 Statement of the problem

Teaching and learning in the 21st century have a lot of peculiarities occasioned by technologies and discoveries. The peculiarities have therefore brought about a paradigm shift in students' satisfaction, especially during times of crisis and trials like the COVID-19 period. Donohue and Wong (1997) have previously found increased satisfaction with a

decrease in the retention rate among the students in online learning. In determining the success of this virtual education, the participants' (teachers and students) satisfaction, therefore, becomes a crucial factor. In the study carried out in Jordan, [Hamdan et al. \(2021\)](#) found instructors to be a crucial determinant of students' engagement and satisfaction in online education. Similarly, other researchers in their studies found the satisfaction of students as essential to the academic outcome of students in online learning ([Costley and Lange, 2016](#); [Cole et al., 2014](#); [Barbera et al., 2013](#)). Online programs and courses are fast becoming the indispensable option for seeking higher education certificates and degrees ([Stephes and Roberts, 2017](#)); it is, therefore, incumbent upon the organizers to improve the morale and the satisfaction of the students in the planned activities. Sequel to the review of previous studies, the onus of this study is to assess virtual learning environment factors as predictors of students' learning satisfaction during the COVID-19 period in Nigeria.

1.2 Objective of the study

The purpose of this study is to assess the roles played by virtual learning environment factors in terms of instructors' support, interaction/collaboration, personal relevance and students' autonomy in tertiary institutions on students' learning satisfaction during the COVID-19 period in Nigeria.

1.3 Research questions

The following research questions were raised to guide the study:

- (1) Is there a difference in students' satisfaction in virtual learning during COVID-19 based on tertiary institution types as mediated by gender?
- (2) To what extent do environmental factors affect virtual learning during the COVID-19 period?
- (3) How do the environmental factors (instructors' support, interaction/collaboration, personal relevance and students' autonomy) predict learning satisfaction during the COVID-19 period?

1.4 Literature review

This study is anchored on the theory of human motivation of McClelland, D.C (1958) which assumes that individuals are motivated by three major needs. These are identified as the need for achievement, need for power and need for affiliation ([Moore et al., 2010](#)). Since motivation is a propelling force that instills the required energy in an individual to push more and more to attain his target not minding any stumbling block, the designers of the programme should endeavour to consider it at every stage of the programme. Motivation is a student's desire to participate in and complete coursework to attain success ([Fieber, 2019](#)). According to [Braden \(2000\)](#), the level of individual needs is not the same: some have high levels, while others have low levels of needs. [Braden \(2000\)](#) further argued that people with high achievement need always seek a solution by all means on their own, usually eager to get feedback on their performances because they would have set appropriate goals. Therefore, they always stretch themselves to have their goal achieved. This theory is suitable to explain students' satisfaction in participating in virtual learning. It addresses the achievement, fulfillment, affiliation and power, which are inevitable needs of every student in all citadels of learning. This theory has been previously used by [Strong et al. \(2012\)](#) as the basis for studying students' satisfaction in eLearning courses. They considered environmental factors and social presence as sources of motivation for students as determinants of their satisfaction in eLearning courses.

1.4.1 Research hypotheses. In the context of Nigeria, it is imperative to propose the following hypotheses where there has been very little research on virtual learning environmental factors as they affect the learning satisfaction of students in tertiary institutions.

1.4.1.1 Instructors' support impacts learning satisfaction during the COVID-19 period. The most important measure of the effectiveness of teaching and learning activities is students' satisfaction, irrespective of where the learning activity takes place and when and how it is organized. To achieve this (satisfaction) as a measure of effectiveness, the instructor or teacher has a key role to play in higher education. [Hettiarachchi et al. \(2021\)](#) asserted that satisfaction can make the academic performance of students better, improve the online teaching and learning itself and encourage students to remain in the program. In the same vein, [Topala and Tomozii \(2014\)](#) described online learning satisfaction as the general feeling of students toward online teaching and learning processes.

It is expected that the more the support students have from their instructors, the more the satisfaction students derive from the online teaching-learning process. To this end, [Garrison et al. \(2000\)](#) reported that instructional management, building understanding and direction of instruction are indicators of an instructor's presence in the online mode of learning. [Martin \(2017\)](#) and [Barbera et al. \(2013\)](#) also found a positive relationship between instructors' interaction, assistance, satisfaction and perceived learning. Cordial relationship between the instructors and the students cum all-around supports have positive impact on the students learning with much fulfillment. Therefore, the instructor should ensure a balance between synchronous and asynchronous learning. However, scholars ([Wiam et al., 2021](#)) report that one of the difficulties usually faced by virtual learning instructors is how to engage learners to be productive. The instructor blends prerecorded learning content and responds to weekly assignments through the internet ([Lee et al., 2018](#)). Furthermore, the level of support students receive during virtual learning is a booster of their interest in online learning. As much as the education cycle cannot be complete without teachers, it is imperative to ensure a harmonious relationship between teachers and learners. [Martin \(2017\)](#) reports that online instructors should interact with the online course format and acquire new online teaching skills which will eventually be transferred to his students. Against this backdrop, the following hypothesis was raised.

H1. There is no significant relationship between instructors' support and learning satisfaction during the COVID-19 period.

1.4.1.2 Interaction and collaboration impacts learning satisfaction during the COVID-19 period. Students feeling disconnected from their teachers and colleagues is one of the challenges of a virtual learning situation ([Gray and DiLoreto, 2016](#)). Students who hitherto before the disruption of face-to-face/physical learning used to interact with teachers and mingle with colleagues suddenly remained indoors and could not physically interact in the class. Interaction and collaboration are essential; however, its efficacy has not been tested in the context of other students' predictors ([Harsasi and Sutawijaya, 2018](#)). The 21st century learning environment is everywhere. It is therefore important for teams or groups of students to come together in their virtual learning community to work on a project, especially academics. This cannot just happen but be deliberately facilitated by their virtual instructor(s). [Sun et al. \(2008\)](#) have found that students who collaborated on a given task in an online course have enunciated their satisfaction in the learning process. According to [Stephes and Roberts \(2017\)](#), an instructor is crucial in this collaborative learning; he/she designs and facilitates interaction. Also, [She et al. \(2021\)](#) found a very high significant relationship between interaction and students' satisfaction in China. They explained further that students who interact with other students during the teaching and learning period tend to be more satisfied than those without interaction. Based on the explanation, the following hypothesis was raised within the Nigerian context.

H2. There is no significant relationship between collaboration and learning satisfaction during the COVID-19 period.

1.4.1.3 Personal relevance impacts learning satisfaction during the COVID-19 period. Students' willingness and desire to learn, coupled with a sense of belonging, cannot be underestimated in virtual learning. Education planners, instructional designers and administrators have to see it as part of their responsibilities to design the curricula meant for virtual learning to match individual needs. Students should be convinced to see the curriculum as the addresser of their needs and the one that has considered individual differences. [Wiers-Jenssen et al. \(2002\)](#) assert that education not only is limited to knowledge and skills acquisition but also has to do with an individual's achievement and development. Studies have confirmed the relationship between social presence and learning satisfaction in developed countries ([Barbera et al., 2013](#); [Strong et al., 2012](#); [Lee et al., 2018](#)). This presupposes that the ambitions, goals and social needs of all students participating in virtual learning must be formally acknowledged, and they must be assisted to actualize them. Contingency theory considers the situation at hand in the structuring of every module to address the yearning and aspirations of the society at first as well as address individual goals in life. It is against this backdrop that the following hypothesis was raised.

H3. There is no significant relationship between personal relevance and learning satisfaction during the COVID-19 period.

1.4.1.4 Students' autonomy impacts learning satisfaction during the COVID-19 period. There is no iota of doubt that all human beings enjoy being independent and free from external control in all their endeavors. Autonomy online gives students the free will to learn and choose between asynchronous and synchronous learning modes. Virtual learning avails every student the opportunity to be independent ([Hamdan et al., 2021](#)) in choosing a course and the modality of the learning process. Furthermore, students' autonomy according to [Abuhassna et al. \(2020\)](#) has to do with the level of freedom to learn, select learning mode and objectives, ask for help when desired, assess their results and learn schemes/syllabus at will. Previous studies found a significant relationship between the learning autonomy of students and positive learning of the Learning Management System (LMS) ([Davis, 2006](#)). This implies that the freedom to learn as one wishes makes virtual learning more attractive, encouraging and student centered. This autonomy will equally have some influences on the satisfaction of students, especially its flexibility. Based on the above, the following hypothesis was raised.

H4. There is no significant relationship between students' autonomy and learning satisfaction during the COVID-19 period.

2. Material and methods

This study adopted a cross-sectional survey design. The design seeks to examine, understand and describe the association among variables as they naturally occur at a fixed point in time ([Polit and Beck, 2014](#)). This design is an efficient way of collecting a large amount of data that can be used to comprehend and solve problems ([Hamdan et al., 2021](#)).

2.1 Sampling and data collection

The survey was conducted with the use of Google Forms. The link was shared via WhatsApp and e-mail to elicit information from students in tertiary institutions in Nigeria who served as the study participants. Since the population is above 250,000, the study sample was 384 using simple random sampling with the aid of [Krejcie and Morgan's \(1970\)](#) guide for determining the sample size. Likewise, the snowball sampling technique was used to locate the students.

The snowball sampling technique was used because due to lockdown, the researchers could not visit the tertiary institutions to get their contacts. The snowball technique assisted the researchers in locating other participants since they have contact with one another. In this study, only 400 surveys were sent out to the participants. However, only 270 tertiary institution students returned the survey. Only students who participated and have spent a minimum of one semester before the lockdown occasioned by the COVID-19 pandemic were selected for this study. The survey(s) that did not indicate the institution and the level of study of participants was excluded. All the 270 returned surveys were valid and usable because they fulfilled the prerequisites for inclusion. Students in public-owned tertiary institutions were the major respondents: they were 248 (91.9%), while those from privately owned higher education institutions were 22 (8.1%).

2.2 Research context

The study was conducted in Nigeria tertiary institutions. There are three institution types in Nigeria: universities, polytechnic/monotechnic institutions and colleges of education. Based on ownership, tertiary institutions in Nigeria are broadly categorized into public and private tertiary institutions. Public tertiary institutions are those established by the federal and state government, while private tertiary institutions are those owned and controlled by individuals, nongovernment organizations and religious groups. There are 49 federal, 57 state-owned and 99 private universities in Nigeria (National Universities Commission [NUC], 2022). On the other hand, among polytechnic/monotechnic institutions, 37 are federal owned, 51 are state owned and 173 are private owned (National Board for Technical Education [NBTE], 2022). Also, among colleges of agriculture and colleges of health, 33 and 62 are federal owned, respectively, there are no state-owned colleges, while 11 colleges of health are private owned (National Board for Technical Education, 2022). There are also 27 federal colleges of education, 4 state colleges of education and 82 private colleges of education in Nigeria (National Commission for Colleges of Education [NCCE], 2022).

2.3 Instrument

A 24-item survey instrument titled “Environmental Factors as Determinants of Satisfaction in Virtual Learning Questionnaire” was used. The questionnaire has three sections. Section A includes demographic information, section B contains questions on environmental factors and section C contains questions on virtual learning satisfaction. There are four items for demographic information, and each of the environmental factors has four items, except for personal relevance which has only two items. Also, six items were raised for students’ satisfaction. Each variable was measured on a 5-point Likert scale as follows: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree.

The questions were adapted from two studies: Strong *et al.* (2012) study on investigating students’ satisfaction with e-learning courses: the effects of learning environment and social presence, and Harsasi and Sutawijaya’s (2018) study on the determinants of student satisfaction in the online tutorial. The adaptation was done from the aforementioned authors because of their similarities but different context. The adapted questionnaire was subjected to a reliability test which yielded 2 Cronbach alpha coefficients. Section B, which contains questions on environmental factors, yielded 0.87, while section C, which contains questions on virtual learning satisfaction, yielded 0.89.

2.4 Method of data analysis

To actualize the purpose of the study, the study used Statistical Package for Social Science (SPSS) IBM version 22 to analyze the data gathered. Descriptive statistics (frequency count

and percentages) were used to analyze the demographic information of the participants, while the hypotheses-cum-research questions were analyzed using inferential statistics (two-way ANOVA and linear regression analysis).

3. Results and discussion

Tables 1–10 provide the demographic data of the participants and answers to the research questions and research hypotheses stated earlier in this study. Only 270 tertiary institution students responded to and returned the instrument. Therefore, the analysis was based on the number of the returned instruments and not the previously projected 384 respondents according to Krejcie and Morgan (1970). Five hypotheses were posited in this study, and the literature confirms that when $p < 0.05$, $p < 0.01$ and $p < 0.001$ are signs that a significant relationship existed among measured and latent variables which then leads to either accepting or rejecting a hypothesis.

Table 1 shows the demographic information of the participants. Based on institution ownership, 22 (8.1%) students were from privately owned tertiary institutions, while 248 (91.9%) were from public (government-owned) institutions. Furthermore, 152 (56.3%) and 118 (43.7%) were male and female participants, respectively. Also, 240 (88.9%) were in the university, 14 (5.2%) from polytechnics and 16 (5.9%) from colleges of education.

RQ1. Is there a difference in students' satisfaction in virtual learning during COVID-19 based on tertiary institution types as mediated by gender?

To what extent do environmental factors affect virtual learning during the COVID-19 period?

- (1) Table 3 indicates that a two-way between-group ANOVA was conducted to explore the impact of sex and tertiary institution types, as measured by satisfaction. Participants were divided into three groups according to their institution types (group 1: universities; group 2: polytechnics and group 3: colleges). The interaction effect between sex and tertiary institution type was not statistically significant, $F(2, 264) = 0.900$, $P = 0.40$. There was no statistically significant main effect for tertiary institution type, $F(2, 264) = 0.599$, $P = 0.55$.

RQ2. How do the environmental factors (instructors' support, interaction/ collaboration, personal relevance and students' autonomy) predict learning satisfaction during the COVID-19 period?

	Frequency	Percent
<i>Institution ownership</i>		
Private	22	8.1
Public	248	91.9
<i>Gender</i>		
Male	152	56.3
Female	118	43.7
<i>Tertiary institution type</i>		
Universities	240	88.9
Polytechnics	14	5.2
Colleges of education	16	5.9
Total	270	100.0

Table 1.
Demographic
information of
participants

Source(s): Fictitious data, for illustration purposes only

Table 2. Descriptive statistics for dependent variable (satisfaction)

Factor A	Factor B	Mean	SD	N
Universities	Male	17.64	6.077	132
	Female	17.91	6.161	108
	Total	17.76	6.104	240
Polytechnics	Male	16.00	4.408	8
	Female	16.33	5.086	6
	Total	16.14	4.521	14
Colleges	Male	19.00	5.878	12
	Female	14.50	2.887	4
	Total	17.88	5.572	16
Total	Male	17.66	5.979	152
	Female	17.71	6.043	118
	Total	17.68	5.996	270

Two-way ANOVA summary (tests of between-subject effects)

Source	Type III sum of squares	df	MS	F	Sig.	Partial eta ²
Corrected model	100.655 ^a	5	20.131	0.555	0.734	0.010
Intercept	16012.397	1	16012.397	441.723	0.000	0.626
Factor A	43.407	2	21.703	0.599	0.550	0.005
Factor B	23.645	1	23.645	0.652	0.420	0.002
A × B interaction	65.282	2	32.641	0.900	0.408	0.007
Error	9569.953	264	36.250			
Total	94082.000	270				
Corrected total	9670.607	269				

Table 3. Differences in students' satisfaction according to tertiary institution type

Note(s): Factor A is tertiary institution type, while factor B is gender; ^aR squared = 0.010 (adjusted R squared = -0.008)

Table 4.

Adjusted R square value for the model summary of predictors of learning satisfaction of students in virtual learning in Nigeria

Model	R	R ²	Adjusted R ²	Std. error of the estimate
1	0.659 ^a	0.435	0.426	4.54273

Note(s): ^aPredictors: (constant), students' autonomy, instructors' support, collaboration and personal relevance

Table 5.

The results of the ANOVA for the model summary of predictors of learning satisfaction of students in virtual learning in Nigeria

Model		Sum of squares	df	Mean square	F	Sig.
1	Regression	4201.972	4	1050.493	50.905	0.000 ^b
	Residual	5468.636	265	20.636		
	Total	9670.607	269			

Note(s): ^aDependent variable: satisfaction; ^bPredictors: (constant), students' autonomy, instructors' support, collaboration and personal relevance

From the result in [Table 4](#), the adjusted R² (0.426) has a good fit. This reveals that the constructed multiple regression model of the independent variables (students' autonomy, instructors' support, collaboration and personal relevance) accounts for 43% variance in the dependent variable (learners' satisfaction). The results of the ANOVA for the model are shown in [Table 5](#).

The results of the ANOVA, $F(df\ 4, 265) = 50.905, p < 0.000$, indicate a statistically significant relationship (stronger than 0.05) between the independent variables and the dependent variable. Based on this significant relationship, the coefficient for the beta weight for the amount of standard deviation unit of change in the dependent variable for each standard deviation unit of change in the dependent variable was calculated. The results are shown in Table 6.

The standardized coefficients in Table 6 revealed that

- (1) The independent variable interaction/collaboration value has the strongest positive effect on students' satisfaction because the beta ($\beta = 0.483, 0.000$) shows a statistically significant relationship and because the alpha value is less than 0.05.

Table 6.
Coefficient for
predictors of
satisfaction of students
in virtual learning in
Nigeria

Model		Unstandardized c coefficients <i>B</i>	Standardized c coefficients Std. error	Beta	<i>t</i>	Sig.
1	(Constant)	1.439	1.360	–	1.058	0.291
	Instructors' support	0.347	0.108	0.203	3.223	0.001
	Interaction/collaboration	0.756	0.112	0.483	6.773	0.000
	Personal relevance	–0.137	0.248	–0.041	–0.551	0.582
	Students' autonomy	0.228	0.106	0.116	2.154	0.032

Table 7.
Relationship between
instructors' support
and learning
satisfaction during
COVID-19

Variables	<i>N</i>	<i>P</i>	Sig.	Remark
Instructors' support	270	0.52	0.000	Rejected
Students' satisfaction	270			

Table 8.
Relationship between
collaboration and
learning satisfaction
during the COVID-19
period

Variables	<i>N</i>	<i>P</i>	Sig.	Remark
Collaboration	270	0.62	0.000	Rejected
Students' satisfaction	270			

Table 9.
Relationship between
personal relevance and
learning satisfaction
during the COVID-19
period

Variables	<i>N</i>	<i>P</i>	Sig.	Remark
Personal relevance	270	0.50	0.000	Rejected
Students' satisfaction	270			

Table 10.
Relationship between
students' autonomy
and learning
satisfaction during the
COVID-19 period

Variables	<i>N</i>	<i>P</i>	Sig.	Remark
Students' autonomy	270	0.40	0.000	Rejected
Students' satisfaction	270			

- (2) The independent variable instructors' support has the next stronger positive effect on students' satisfaction because the beta ($\beta = 0.203, 0.001$) shows a statistically significant relationship and because the alpha value is less than 0.05.
- (3) The independent variable student autonomy has the next stronger positive effect on students' satisfaction because the beta ($\beta = 0.116, 0.032$) shows no statistically significant relationship and because the alpha value is higher than 0.05.
- (4) The independent variable personal relevance has the next stronger negative effect on students' satisfaction because the beta ($\beta = -0.041, 0.582$) shows no statistically significant relationship and because the alpha value is higher than 0.05.

3.1 Hypothesis 1 The relationship between instructors' support and virtual learning satisfaction during COVID-19 was investigated using the Pearson product-moment correlation coefficient. There was a strong positive correlation between the two variables, $r = 0.52$, $n = 270$, $p < 0.000$, with a high level of instructor support associated with a high level of learning satisfaction during the COVID-19 period.

3.2 Hypothesis 2 The relationship between collaboration and virtual learning satisfaction during COVID-19 was investigated using the Pearson product-moment correlation coefficient. There was a strong positive correlation between the two variables, $r = 0.62$, $n = 270$, $p < 0.000$, with a high level of collaboration associated with a high level of learning satisfaction. Hence, the null hypothesis that there is no relationship between collaboration and virtual learning satisfaction during COVID-19 is rejected.

3.3 Hypothesis 3 The relationship between personal relevance and virtual learning satisfaction during COVID-19 was investigated using the Pearson product-moment correlation coefficient. There was a strong positive correlation between the two variables, $r = 0.50$, $n = 270$, $p < 0.000$, with a high level of personal relevance associated with a high level of learning satisfaction. Hence, the null hypothesis that there is no relationship between personal relevance and virtual learning satisfaction during COVID-19 is rejected.

3.4 Hypothesis 4 The relationship between students' autonomy and virtual learning satisfaction during COVID-19 was investigated using the Pearson product-moment correlation coefficient. There was a strong positive correlation between the two variables, $r = 0.40$, $n = 270$, $p < 0.000$, with a moderate level of students' autonomy associated with a high level of learning satisfaction. Hence, the null hypothesis is that there is no significant relationship between students' autonomy and learning satisfaction during the COVID-19 period.

3.5 Discussion

This study examined virtual learning environmental factors as predictors of students' learning satisfaction during the COVID-19 pandemic lockdown in Nigeria. Based on the results, it is evident that the instructors' support and interaction/collaboration among students predicted students' learning satisfaction in the virtual learning environment. It is therefore believed that when an effort is made to develop these identified factors further, more satisfaction that will translate to positive academic success among students will be achieved. These results are corroborated by [Barbera et al. \(2013\)](#) and [Harsasi and Sutawijaya \(2018\)](#) who found that assistance provided by instructors in online learning to students predicted

learning satisfaction. In addition, the study conducted by Ali and Ahmad in 2011 on the key factors for determining students' satisfaction in distance learning courses in Allama Iqbal Open University in Pakistan also supported the finding on students' interaction and collaboration as determinants of students' satisfaction in virtual learning (Ali and Ahmad, 2011).

However, it is also evident from the results of this study that personal relevance and students' autonomy insignificantly predict students' satisfaction in virtual learning. This might have been caused by the fact that students of higher education institutions relatively enjoy some freedom even in traditional face-to-face classrooms compared to those of other lower education levels. This outcome, therefore, disagrees with the finding of Strong *et al.* (2012) who found a significant relationship between personal relevance, students' autonomy and students' satisfaction with online learning.

Furthermore, the result of this study reveals that the interaction effect between sex and tertiary institution type was not statistically significant. This implies that gender type in terms of being a male or female student did not affect the level of learning satisfaction among the students. Similarly, the type of higher education institutions (university, polytechnic or college) that the students attend did not have any effect on the students' satisfaction with virtual learning. This conforms to Hamdan *et al.* (2021) who did not find any significant difference in the level of students' satisfaction in online learning based on their gender difference. This outcome is an indicator that the earlier identified environment factors must be systematically and meticulously developed and managed to accommodate the individual needs for satisfaction irrespective of gender and other demographic characteristics of the students.

In addition, the result from the hypotheses revealed that all the environmental factors in virtual learning have a positive relationship with students' satisfaction. Both the independent and dependent variables move in the same direction. These findings agree with the finding of Lee *et al.* (2019) that six factors are essential in virtual learning for students' satisfaction.

4. Conclusions

This study contributes to the existing research bank on the role environmental factors (instructors' support, interaction/collaboration, personal relevance and students' autonomy) play in the satisfaction with virtual learning of students of higher education institutions. The study was able to confirm that instructors' support for students and interaction cum collaboration among students to get tasks done as it happens in traditional face-to-face learning classrooms predicted satisfaction in virtual learning. This presupposes that school management and the quality assurance department in the education ministry should put more effort to improve instructor–student interaction. Likewise, students' autonomy and personal relevance should be looked into to further sustain the satisfaction level attained so far and to encourage more participation in virtual learning as the best alternative during the time of crisis or emergency similar to the COVID-19 pandemic. To summarize, this study has established a relationship between environmental factors and students' learning satisfaction via virtual mode. This implies that the government and tertiary institutions' authorities need to address the suitability of the environmental factors on their learners when using the virtual mode. Further studies could be conducted to unravel why the two variables did not predict learners' satisfaction in the virtual classroom.

4.1 Limitation

Despite the fact that this study provides important information on the role of environmental factors in students' virtual learning satisfaction during the COVID-19, it has some limitations. The self-reported close-ended survey limits the in-depth understanding of the variables

studied. Future research could explore the variables using a qualitative approach, and this will give an in-depth understanding of the study variables.

4.2 Recommendation

Based on the findings of this study, it was recommended that school administrators not discontinue virtual learning after the COVID-19 pandemic but rather introduce a hybrid learning style where both traditional face-to-face learning and online learning coexist, considering the gains of its adoption and the direction in which the whole world is going. Building on this, the instructional designers must be provided with relevant information about the students and the available learning tool to design an all-satisfying curriculum for virtual learning. Likewise, students' autonomy and personal relevance should be looked into, and further studies could be conducted to unravel why the two variables did not predict learners' satisfaction in the virtual classroom. Finally, the government should also stabilize the supply of electricity and find a means of providing more access to good internet, especially for her school-going citizens to strengthen virtual learning.

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