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Students' interactions, satisfaction and perceived progress in an online class: Empirical evidence from Babcock university Nigeria

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Abstract: This study examined the effect of students' interactions on satisfaction and perceived progress in an online class; and the mediating effect of satisfaction on the relationship between students' interactions and perceived progress. A sample survey was conducted among students from Babcock University, Nigeria, as a case study. Quantitative data was collected from 245 students (undergraduate and graduate students who attended exclusively online classes during COVID-19 lockdown) using a questionnaire (online administered). Analysis was done using structural equation modeling. Findings revealed that students' interactions (student-student, student-teacher, and student-content) had positive effects on students' satisfaction and perceived progress in an online class and that satisfaction

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Oluyemi Folorunso Ayanbode

PUBLIC INTEREST STATEMENT

Critical observations reveal that COVID-19 lockdown has necessitated the adoption of online learning by some Nigerian universities as an alternative means of teaching and learning. Most of these universities had engaged in online teaching and learning for the first time. This study has examined the effect of students' interactions on satisfaction and perceived progress in an online class during the COVID-19 lockdown. It also examined the mediating effect of satisfaction on the relationship between students' interactions and perceived progress. The research model was developed based on Moore's framework. Four hypotheses were tested to address the research objectives. Students' interactions in the online class were categories into student–student, student-teacher, and student-content. Findings of this present study reveal that satisfaction significantly mediated the relationship between interactions and perceived progress. The emergency of online teaching and learning triggered by the COVID-19 pandemic has proved the efficacy of technologies in facilitating interactive learning without boundaries and the university authority may have to consider the adoption of hybrid learning, which incorporates both traditional and online learning systems.

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significantly played a mediating role in the relationship between interactions and perceived progress. Student–teacher interaction had the highest loading on interactions which in turn had a strong positive effect on both students' satisfaction and perceived progress.

Subjects: Educational Psychology; Behaviour; Teaching

Keywords: interactions; students' satisfaction; perceived progress; online class; university education; Nigeria

1. Introduction

Interaction in learning environment is significant to gaining new knowledge and cognitive progression (Barker, 1994). Knowledge acquisition and cognitive development are indicators of learning outcomes or students' progress. Therefore, interaction is indispensable to learning in an online environment (Lin et al., 2016), if effective teaching and learning is to be achieved. According to Song and McNary (2011), student interaction is one major determinant of students' learning experiences in the virtual learning environments. The comprehension of students' virtual interactions is crucial because interaction has a significant effect on the quality of online learning (Trentin, 2000). But how is virtual interaction achieved? While students in traditional classrooms interact physically in or outside of class, students in virtual environments may solely interact via collaborative technologies such as email, chat rooms, discussion boards or learning management systems (song & McNary, 2011). Such interaction that is technology-mediated is experienced in a distance learning environment. Moore (1989) categorized interactions in an online education into three types: student-content, student-teacher, and student–student. A shift from face-to-face interaction to virtual interaction is determined by a number of factors, such as overcoming distance barrier, curtailing the spread of infectious diseases, and so on.

In Nigeria for example, many private and public universities shifted from traditional face-to-face learning to online learning in order to curtail the spread of COVID-19. The COVID-19 pandemic resulted to nationwide school closures in several countries which affected many of the students (Misirli & Ergulec, 2021). This measure was considered crucial to reducing the spread of COVID-19 (Abdulamir & Hafidh, 2020). Hence, classes at all levels shifted from traditional to online-learning and efforts are made to design and deliver online courses through the different technologies (Misirli & Ergulec, 2021). Interaction in such an environment differs depending on the type of interaction. Moreover, social factor such as socialization determines the participation of students in both traditional and online classes (Mates et al., 2021). "It is therefore important, to clearly identify which types of interaction are the most critical in specific online learning contexts" (Zhang & Lin, 2019) in Nigeria.

Baber (2020) acknowledged that the COVID-19 pandemic has immensely altered normalcy across the world, particularly those activities of teaching and learning. He opined that the change to online teaching and learning during these unusual times has become the new normal and has equally led many researchers to focus on investigating learning outcomes and students' satisfaction in this virtual learning environment. Moreover, Jiang, Wang et al., (2021) found that students "did not actively communicate and work" with each other in face-to-face classes, and "students were unwilling to interact with" teachers (Jiang, Wang et al., 2021, p. 11; Jiang, Islam et al., 2021). This finding implies that student–student interaction and student–teacher interaction are not as active as expected, and should raise concerns. This is especially true for online classes, and more studies should pay attention to the interaction in online classes.

Hence, this current study examined the relationships among students' interactions, satisfaction, and perceived progress in a private university in Nigeria.

1.1. Statement of the research problem

Online learning research is mostly devoted to establishing the similarity or dissimilarity in the learning gains between physical and virtual students (Kuo, 2010). Others have considered relationships among interactions, learning outcomes, and predictors of learning outcomes (Lin et al., 2016). Specifically, Kuo (2010) examined the effects of the three types of interaction, Internet self-efficacy, and self-regulated learning on student satisfaction. All these studies are in the context of developed countries. Little is known about what obtains in a developing country such as Nigeria. Furthermore, despite the fact that Lin et al. (2016) found that students' interaction is vital to their satisfaction and perceived progress, little is known about the mediating effect of students' satisfaction on the relationship between students' online interactions and perceived progress.

Critical observations reveal that COVID-19 lockdown has necessitated the adoption of online learning by some Nigerian universities as an alternative means of teaching and learning. Most of these universities had engaged in online teaching and learning for the first time. Hence, there is a dire need for an appraisal of the initiatives from the students' perspective for vital feedback that will inform policy making. No existing research has examined the students' interactions, satisfaction, and perceived progress in online class in the context of Nigeria. The lack of this vital information may lead to inability of many universities in Nigeria to effectively harness this window of opportunity and other best practices of e-learning in higher education. The present study will be useful to policy makers in Nigeria university education with respect to the deployment of virtual learning systems to support teaching and learning. It will also enable Babcock University (BU) management to make an informed decision on the possibility of a permanent integration of virtual learning into the traditional learning system. It is equally envisaged that the findings of this study will guide the management of BU on how best to operate and sustain the open distance learning with full deployment of emerging technologies.

2. Theoretical framework

2.1. Moore's (1989) classification of interaction

The classification of interaction into three types was done by Moore (1989). In his framework, he conceptualized interaction as made up of three types, namely: (i) student–content interaction, (ii) student–teacher interaction, and (iii) student–student interaction. To him, distance educators' coming to term with the distinction among the types of interaction conceptually is crucial to overcome inherent disagreement among the educators. This study adopted the Moore's framework to examine the effects of student–content interaction, student–teacher interaction, and student–student interaction on students' satisfaction and perceived progress. The framework presents an apparent, measurable variable to assess the effect of interaction in online teaching and learning (Roblyer & Wiencke, 2003). Applying Moore's framework will make us comprehend interactions that exist among teacher, student, and content and their impacts on online classes (Lin et al., 2016). Moore's framework has been extensively adopted in studies of virtual learning, such as the studies by (Jung et al., 2002; Kuo, 2010; Kuo et al., 2014; Lin et al., 2016; Zhang & Lin, 2019). This current study equally adopted the study of Lin et al. (2016), with the intention to extend it.

Lin et al. (2016) deployed inferential statistics to examine the effects of Moore's (1989) three types of interactions: student-teacher, student–student, and student-content on students' perceived progress and satisfaction. Precisely, 466 students of a Midwestern virtual school took part in the study. They found that student–teacher interaction and student–content interaction were predictors of students' satisfaction respectively, but student–student interaction did not have significant impact on students' satisfaction. Furthermore, only student–content interaction significantly predicted students' perceived progress. However, they did not examine the effect of students' satisfaction on perceived progress, neither did they examine the mediating effect of students' satisfaction on the relationship between the interaction and perceived progress, which this present study seeks to examine. We believe that students' satisfaction with the interactions in

the online class will drive their learning outcomes. According to Lin et al. (2016), previous studies have shown that students' satisfaction with interaction in online class more likely influence their success in the online class. We opine that perceived progress should be a product of both the interactions and students' satisfaction with level of interactions in an online class. If students are contented with the level of interactions there is high possibility they become motivated for further learning engagements; which will impact on their learning outcomes.

3. Conceptual framework and hypotheses

In figure 1, satisfaction and perceived progress are dependent or endogenous variables, while interaction(s) is independent or exogenous variable. Satisfaction with interactions in an online class is expected to drive perceived progress. Interactions include: student–student, student-teacher, and student-content, which are expected to directly and positively influence students' satisfaction and perceived progress.

Figure 1. Hypothesized model of students' interactions, satisfaction and perceived progress.
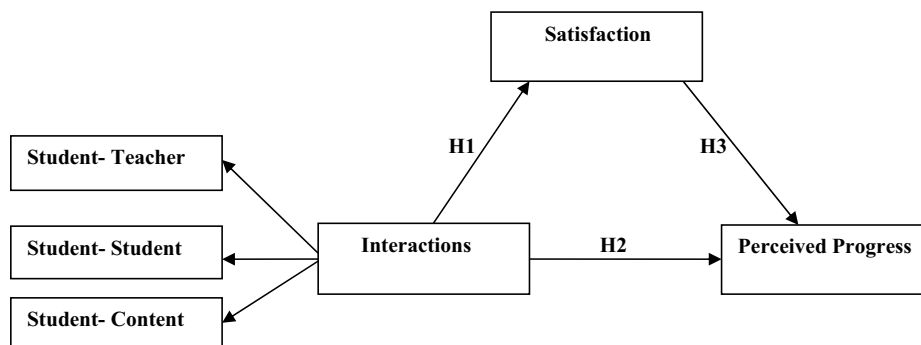
3.1. Interactions in an online class

Interaction in an online class is essential for the effective and efficient learning process and outcome of an instructor (Zhang & Lin, 2019). Interaction in an online class is the act of communicating curriculum content or learning materials via the internet or any online classroom (Misirli & Ergulec, 2021). Interaction is known among many as the act of expressing the curriculum content of undergraduate and post-graduates in higher institutions of learning. Interaction in an online class enhances learning, teaching and adds value to the student by improving retention (Moore, 1989). There are three major types of interactions, namely:

   Student–content interaction: In this interaction, the student interacts and obtains information directly from learning materials. The study of student interaction and role of teachers in a state virtual high school done by Zhang and Lin (2019) revealed that only student–content interaction significant impacted their satisfaction. Student–content interaction involves the use of software application such as PowerPoint Presentation, audio-visual presentations, group tasks, individual assignments, and integrated course resources (Mark et al., 2005; as cited in Zhang & Lin, 2019). In this process, the student participates in intellectual activities using his or her problem-solving and critical thinking skills. Student–content interaction results in a positive and motivational outcome, deep understanding, and knowledge sharing (Beldarrain, 2008). The design of the content is critical to knowledge sharing between the teacher and the students, and among the students (Beldarrain, 2008). Moreover, Oliver et al. (2009) found that once students are learning in virtual environments, they are usually self-motivated to take part in content-oriented interaction.

   Student–student interaction exists when two or more people or groups of students come together during class discussion, assignment, or project to work together as a team to achieve

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a given task (Lin et al., 2016; Moore, 1989). Student–student interaction results in the participation of every member and a high satisfaction rate among participants (Kuo, 2010). Student–student interaction should be considered when developing course content, this enables students to collaborate, share information, and respond to query, while the lecturers receive feedback from students (Zhang & Lin, 2019). Kurucay and Inan (2017) conducted a study using quasi experimental design and found out that student–student interaction significantly predicted students' achievement but had no effect on their satisfaction.

Student–teacher interaction: In this interaction, the teacher delivers information based on the curriculum, receives feedback, and guides students by allowing the students interact with the instruction via communicating and asking questions (Zhang & Lin, 2019). In addition, it allows for monitoring of student course performance and participation. Student–teacher interaction renders prompt feedback to students. It requires timely feedback systems, class discussions, and use of appropriate collaborative technologies (Barbour & Plough, 2009; Beldarrain, 2008). However, Moore (1989) asserted that student–teacher interaction usually has greater influence on the student much more than when there is only student–content interaction. Furthermore, in the study done by Liu and Cavanaugh (2012), they reported that student–teacher interaction had a positive impact on the final result score in a virtual high school algebra course.

3.2. Interaction and students' satisfaction

Students' satisfaction in online class refers to students' contentment with the interactions (student–student, student-teacher, and student-content), or learning experiences in a virtual class (Dziuban et al., n.d.). Alquarashi (Alqurashi, 2019) in his study explored the effects of virtual learning self-efficacy, student–content interaction, student–teacher interaction, and student–student interaction on students' satisfaction and perceived learning. His findings revealed student–content interaction as the strongest predictor of student satisfaction, and that student–student interaction never predicted students' satisfaction. On the other hand, Su and Guo (C-y & Guo, 2021) investigated factors impacting university students' online learning experiences during the COVID-19 epidemic. They found that student–student interaction and student–content interaction had positive effect on students' satisfaction respectively. Baber (2020) examined the predictors of perceived learning outcomes and their impacts on students' satisfaction. His findings revealed that interaction in the classroom, among others significantly impacted students' satisfaction. Joo et al. (2011) used structural equation modeling (SEM) to establish cause-and-effect inferences, and they found that the teaching presence (teacher–student interaction) and cognitive presence (student–content interaction) were among the significant predictors of students' satisfaction. Similarly, we proposed that:

H1. *Interaction has positive effect on students' satisfaction*

3.3. Interaction and students' perceived progress in online class

Students' perceived progress in online class refers to students' self-report of improvement or advancement in skills, cognition, knowledge, academic grades or scores generally based on some observations (Bacon, 2016). Previous studies have established a significant relationship among interactions (student–student, student-teacher, and student-content) and students' perceived progress (Lin et al., 2016; Liu & Cavanaugh, 2012; Zhang & Lin, 2019). Earlier, Eom et al. (2006) have found that interaction did not significantly affect student's perceived progress. This may be because in their study, they conceptualized interaction as a single indivisible component.

Recently, Baber (2020) examined the predictors of students' learning outcomes and their impact on students' satisfaction. He found that interaction in the classroom is one of the factors that positively influenced students' perceived learning outcomes. As a matter of fact, Lin et al. (2016) considered interaction based on Moore's interaction framework which indicated that interactions take place among teacher, student, and content. They found that perceived progress was predicted by

student–content interaction, but was not predicted by student–student and student–teacher interactions. Similarly, Gray and DiLoreto (2016) concluded that the result of their study showed positive significant relationship between student-content interaction and perceived progress. Costley and Lange (2016) in their work; attempted to provide answers to whether teachers can influence satisfaction and perceived learning via varieties of instructional designs or not. They found that increasing the levels of teachers' control in the online classes significantly impacted on perceived learning.

There is evidence that student–teacher interaction has a significant impact on perceived progress when a teacher goes beyond performing his relevant roles to establish control in the course content, discussions, and related activities (Shea et al., 2006) but also adds values to enhance his course content by asking student feedback pertaining to the course of study, and deploys feedback mechanism to increase student academic advancement (Jaggars et al., 2013, April, p. 6). Hence, we proposed that:

H2. *Interaction has positive effect on students' perceived progress*

3.4. Students' satisfaction and perceived progress in an online class
According to Shea et al. (2003), a significant relationship exists between students' satisfaction and perceived progress, if students are allowed to interact with other colleagues (student–student interaction) and are also provided the opportunity to interact with their instructors (student-teachers). Eom et al. (2006) investigated the predictors of students' perceived learning outcomes and satisfaction. They deployed SEM to establish the predictors of students' satisfaction and students' perceived learning in the university virtual classes. From their findings, they concluded that their model showed that students' satisfaction significantly predicted learning outcomes. They noted that virtual teaching and learning can be a highly rewarding method of instruction once it is students-centric with specific learning techniques and with timely, meaningful, and diversified teacher's feedback.

Similarly, Gray and DiLoreto (2016) examined the relationships among course design, students' interaction, students' engagement, instructor presence, students' satisfaction and perceived learning. Just 216 students completed online survey. They found that students' satisfaction and perceived learning had the strongest relationship ($r = 85$, $\rho < 01$). Therefore, we proposed that:

H3. *Students' satisfaction has positive effect on perceived progress*

H4. *Students' satisfaction mediates the relationship between students' interactions and perceived progress*

4. Methods

4.1. Research design
This study employed a survey study design. The survey study accentuates the objectivity and reliability of findings and supports the generalization of results. This is also to enhance the capturing of responses from widely dispersed participants.

4.2. Sampling
Babcock University (BU), Nigeria was taken as a case study for in-depth understanding of what is being studied. At the time of the study, BU had over 10,000 students. A sample of 385 students was selected via convenience sampling technique.

4.3. Context of the study
This study was carried out in a private university in Southwest Nigeria: Babcock University. Babcock University (BU) began its existence on 17 September 1959. Located in Ilisan-Remo,

Ogun State, BU is one of the first three private universities announced by the Federal Government of Nigeria under the leadership of President Olusegun Obasanjo on 20 April 1999, and was later given a certificate of registration on 10 May 1999. Currently, it has nine different schools and 44 faculties, and it has a population of over 10, 000 students comprising both undergraduates, and postgraduates.

BU swiftly moved from the face-to-face teaching and learning method to the online teaching and learning to keep the students engaged via online classes, since 23 March 2020; when the University announced the decision of the State and Federal Government to shutdown educational sector as a way of curbing the continuous wide spread of Covid-19 in Nigeria. Hence, all forms of interactions were done virtually. For some years, BU has engaged students on Computer-based Examination and as a result, it was easy to transit from the face-to-face method of teaching and learning to virtual teaching and learning. BU is a host to New Horizon; a company whose main objective is centered on e-learning and distance education. In view of this, BU has commissioned a gigantic building well furnished with computers and the accessories, mainly for e-learning and distance education. Faculty members worked tirelessly to develop the course content and also uploaded it for further dissemination to the students. In order to continue to serve the university community better in terms of teaching and learning, faculty members were trained on the effective use of learning management systems such as Edmodo, Google Classroom, Zoom, Google Hangouts, and a host of others. Students were also not left behind in this regard.

The students' interactions cut across taking lecture, writing quizzes, submitting assignments, class group discussions, taking mid-semester assessments, and even final examinations via different learning management systems such as Google Classroom, Zoom, WhatsApp, Google Hangouts, Edmodo, and many others. From observations, the online interactions have yielded huge successes because instructors have been able to interact with the students through teaching, conducting continuous assessment, and semester examination as well as uploading assessment report seamlessly with the aid of the functional internet connectivity on BU Campus. Beyond teaching and learning, students have been graduated virtually and this is to show that students' online experiences have been worthwhile. It is expected that the findings of this study will justify these assumptions.

4.4. Instrumentation
A questionnaire was used for data collection. A 5-point Likert scale was deployed to measure the variables, codified as strongly agree (SA = 5), agree (A = 4), undecided (U = 3), disagree (D = 2) to strongly disagree (SD = 1). The structured questionnaire contained questions on the demographic characteristics of the students, their interactions (it contained 10 items, six items adopted and modified from Kuo, 2010), satisfaction (it contained three items, two items adopted and modified from Kuo, 2010), and the perceived progress in an online class (it contained three items, one item adopted and modified from Lin et al., 2016). Content validity of the questionnaire was done via review by two experts in the field. To ascertain the reliability of the questionnaire, it was pre-tested on 10 students from Christland University Ajebo Road, Abeokuta. Copies of the self-administered questionnaire were distributed (online via Google Forms) to 385 respondents.

4.5. Reliability analysis
The internal consistency of the whole questionnaire was investigated. The Cronbach's alpha value for the questionnaire was 0.96, which was greater than the recommended 0.70.

4.6. Response rate
Out of 385 students sampled for the questionnaire distribution between December 2020 and March 2021, 245 of them correctly completed the questionnaire, representing a response rate of 63.64%. Rubin and Bellamy (2012) recommended that 50% is an acceptable response rate.

4.7. Data analysis

Data was analyzed using SPSS for Windows. Based on the conceptualized hypothesized model for this study, the measurement model was assessed via Confirmatory Factor Analysis (CFA), followed by the SEM assessment. AMOS 23 was used for the SEM. Maximum Likelihood method was used to calculate estimates for regression weights, correlations, variances and so on. Table 1 and 2 presents the constructs and related items, and Table 3 and Table 4 present the descriptive statistics (mean and standard deviation) and correlations of the items (observed variables), respectively.

Table 1. Coding and labeling of data	
Code	**Items**
	Interactions
SSI9	*I communicated with my classmates about the course content through different technologies, such as WhatsApp, instant messaging tools, etc.*
SSI10	*I answered questions of my classmates through different technologies, such as WhatsApp, instant messaging tools, etc.*
SSI12	*Class projects or assignments led to interactions with my classmates*
STI13	*I had numerous interactions with the teachers during the class.*
STI15	*Teachers responded to students' questions promptly*
STI19	*Teachers initiated discussion to further explain the topic*
SCI22	*Online course materials helped me to understand better the class content.*
SCI23	*Online course materials stimulated my interest for this course*
SCI24	*Online course materials helped relate my personal experience to new concepts or new knowledge.*
SCI26	*Online presentations helped me gain new concepts or new knowledge.*
	Satisfaction
SAT30	*I am satisfied with the participatory learning experience*
SAT31	*I am satisfied with the level of interactions that happened in the class*
SAT32	*I am satisfied with the absence of intimidation usually experienced during face-to-face communication*
	Perceived progress
PEP35	*I understand most of the content in the class*
PEP36	*My communication skill has improved*
PEP38	*Opportunities for collaborative activities after the class have increased*

Key: *SSI = student–student interaction, STI = student–teacher interaction, SCI = student–content interaction, SAT = students' satisfaction, PEP = perceived progress.*

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Table 2. Demographic data of the respondents, N = 245			
Variables		**Frequency**	**Percent**
Sex	Male	59	24.1
	Female	186	75.9
Marital status	Single	213	86.9
	Married	32	13.1
Age	16–20	174	71.0
	21–25	24	9.8
	26 – 30	17	6.9
	31–35	12	4.9
	36–40	2	0.8
	41–45	7	2.9
	46 and above	9	3.7
Level of study	Undergraduate	234	95.5
	Graduate	11	4.5
School	School of Computing and Engineering Sciences	4	1.6
	School of Education and Humanities	7	2.9
	School of Law and Security Studies	11	4.5
	School of Management Sciences	31	12.7
	School of Science, Technology, and Applied Sciences	3	1.2
	Veronica Adeleke School of Social Sciences	91	37.1
	College of Health and Medical Sciences	23	9.4
	School of Nursing	73	29.8
	School of Public and Allied Health	2	0.8

Table 3. Descriptive statistics				
Variables	**Items**	**Range**	**Mean**	**Std. Dev**
Student-Student Interaction	SSI9. I communicated with my classmates about the course content through different technologies, such as WhatsApp, instant messaging tools, etc.	4	4.31	1.005
	SSI10. I answered questions of my classmates through different technologies, such as WhatsApp, instant messaging tools, etc.	4	4.10	1.192
	SSI12. Class projects or assignments led to interactions with my classmates	4	4.19	1.056
	Average Mean = 4.20 Average Std. Dev = 1.084			

(Continued)

Table3. *(Continued)*				
Variables	**Items**	**Range**	**Mean**	**Std. Dev**
Student-Teacher Interaction	STI13. I had numerous interactions with the teachers during the class.	4	3.20	1.355
	STI15. Teachers responded to students' questions promptly	4	3.76	1.243
	STI19. Teachers initiated discussion to further explain the topic	4	3.75	1.244
	Average Mean = 3.57 Average Std. Dev = 1.281			
Student-Content Interaction	SCI22. Online course materials helped me to understand better the class content.	4	2.88	1.533
	SCI23. Online course materials stimulated my interest for this course	4	2.92	1.532
	SCI24. Online course materials helped relate my personal experience to new concepts or new knowledge.	4	3.11	1.458
	SCI26. Online presentations helped me gain new concepts or new knowledge.	4	3.10	1.510
	Average Mean = 3.00 Average Std. Dev = 1.508			
Satisfaction	SAT30. I am satisfied with the participatory learning experience	4	3.40	1.415
	SAT31. I am satisfied with the level of interactions that happened in the class	4	3.42	1.382
	SAT32. I am satisfied with absence of intimidation usually experienced during face-to-face communication	4	3.51	1.464
	Average Mean = 3.44 Average Std. Dev = 1.420			
Perceived Progress	PEP35. I understand most of the content in the class	4	3.27	1.335
	PEP36. My communication skill has improved	4	3.41	1.390
	PEP38. Opportunities for collaborative activities after the class have increased	4	3.48	1.317
	Average Mean = 3.39 Average Std. Dev = 1.347			

Valid N = 245 in each case.

Table 4. Correlations

	STI19	SAT32	PEP38	PEP35	PEP36	SSI12	SCI26	SCI24	SCI23	SCI22	STI13	STI15	SSI10	SSI9	SAT31	SAT30
STI19	1.000															
SAT32	.475	1.000														
PEP38	.531	.471	1.000													
PEP35	.604	.530	.702	1.000												
PEP36	.519	.476	.742	.715	1.000											
SSI12	.380	.339	.311	.390	.421	1.000										
SCI26	.419	.351	.458	.539	.505	.276	1.000									
SCI24	.411	.368	.462	.456	.456	.247	.706	1.000								
SCI23	.465	.382	.452	.472	.476	.253	.732	.823	1.000							
SCI22	.369	.354	.337	.400	.350	.209	.680	.716	.851	1.000						
STI13	.587	.420	.545	.633	.585	.399	.559	.449	.498	.424	1.000					
STI15	.663	.408	.506	.551	.461	.410	.476	.472	.455	.379	.582	1.000				
SSI10	.352	.378	.272	.338	.339	.489	.340	.177	.211	.226	.378	.285	1.000			
SSI9	.380	.362	.334	.328	.346	.569	.357	.289	.301	.253	.390	.434	.596	1.000		
SAT31	.648	.569	.581	.631	.645	.408	.482	.405	.454	.378	.617	.568	.352	.387	1.000	
SAT30	.576	.478	.603	.597	.633	.352	.495	.452	.452	.351	.609	.579	.282	.368	.771	1.000

5. Results

5.1. Demographic characteristics of the respondents

Two hundred and forty-five students from nine faculties participated in the study, majority 91 of them were from Veronica Adeleke School of Social Sciences (see, Table 2). Just 59 (24.1%) of the respondents were males while more than half, 186 (75.9%) were females. The majority, 213 (86.9%) of the respondents were single. More than half, 174 (71.0%) of the respondents were in the age group of 16–20 years and 24 (9.8%) were 21–25 years. Twenty-one (4.9%) were within the age group of 31–35 years, seven (2.9%) were within the age group of 41–45 years and nine (3.7%) were 46 years and above. The mean age of the respondents was 19.78 years. The majority, 234 (95.5%) were undergraduates, while just 11 (4.5%) were at the graduate level of study.

5.2. Descriptive statistics and correlations

Table 3 shows the means and standard deviations (SD) of all items (observed variables). Among the types of interaction, student–student interaction had the highest average mean (M = 4.20, SD = 1.084), followed by student–teacher interaction (M = 3.57, SD = 1.281), and student–content interaction (M = 3.00, SD = 1.508).

Table 4 presents the correlations of all items. All items had significant correlations with one and another at p < 0.50.

5.3. Measurement model

Figure 3 presents the result of CFA. The model consists of two first-order constructs: (i) students' satisfaction (ii) perceived progress, and one second-order construct: Interaction, indicated by three sub-constructs namely: (i) student–student interaction (ii) student–teacher interaction, and (iii) student–content interaction. We proposed a second-order CFA model for the interaction construct (as a single indivisible component, in which student–student, student-teacher, and student–content interactions are conceptualised as the manifest variables) based on the study done by Eom et al. (2006), and we further examined the structural relationship between each component of interaction and satisfaction/perceived progress based on Moore's (1989) framework and the study done by Lin et al. (2016). Moreover, to operationalize the concept of "interactions," we first validated three first-order factors of interactions (as shown in Figure 2), and then tested a second-order factor of Interactions measurement model (see, figure 3).

figure 2 presents the CFA model of the three first-order factors of interactions. The model fit indices show that the model is acceptable for modeling a second-order factor of interactions.

Figure 2. CFA measurement model (Three first-order factors of interaction). Key: SSI = student–student interaction, STI = student–teacher interaction, SCI = student–content interaction.
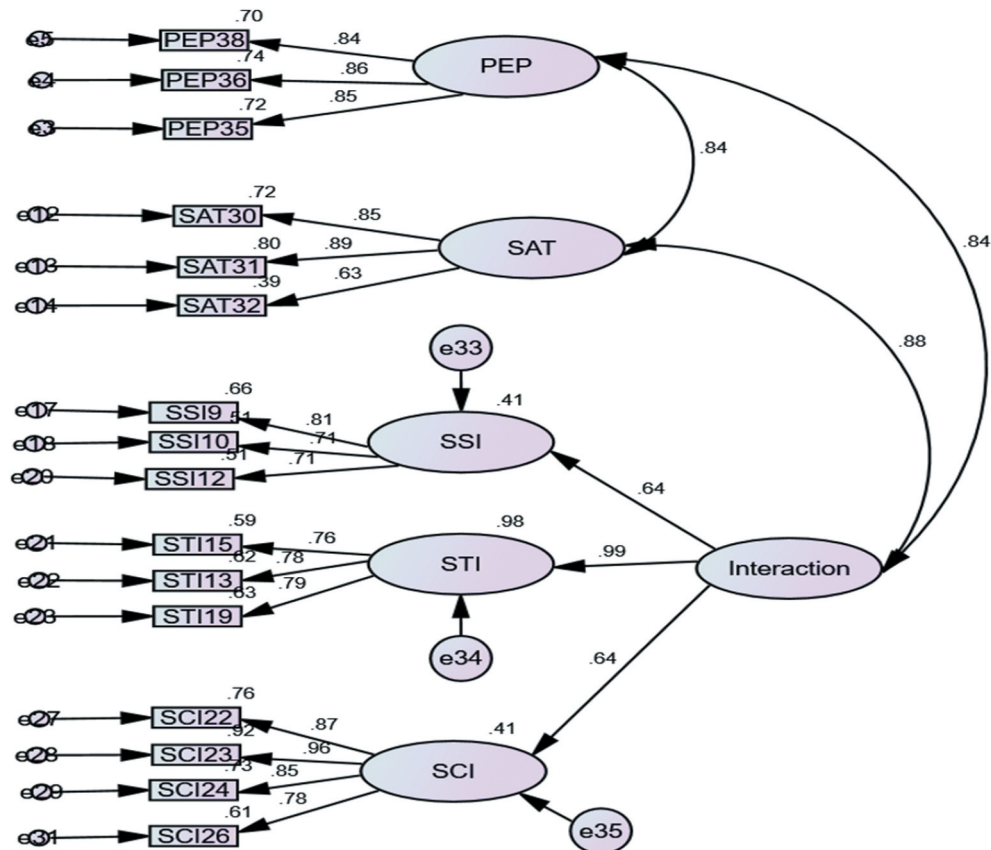
5.3.1. Model fit indices
$P < 0.0001$, $X^2 = 81.538$, $df = 32$, $X^2/df = 2.548$, GFI = 0.940, RMSEA = 0.080 (0.058–0.101), TLI = 0.953, CFI = 0.967, RMR = 0.085; SRMR = 0.0468

figure 3 shows a measurement model with interaction modeled as a second-order construct. Evidence shows that the three first-order factors loaded well (0.64, 0.99, and 0.64) on Interactions.

Furthermore, based on Kline's (2005) recommendation that significant chi-square, RMSEA < 0.10, with 90% confidence interval, CFI >0.90, and SRMR <0.10 are considered favourable. figure 3 shows that the model fits the observed data and is acceptable for structural modeling.

Figure 3. CFA measurement model. *Key: SAT = students' satisfaction, PEP = perceived progress, SSI = student–student interaction, STI = student–teacher interaction, SCI = student–content interaction.*

5.3.2. Model fit indices
$P < 0.0001$, $X^2 = 194.255$, $df = 98$, $X^2/df = 1.982$, GFI = 0.911, RMSEA = 0.063 (0.050–0.076), TLI = 0.956, CFI = 0.964, RMR = 0.093; SRMR = 0.0498

5.4. Construct reliability
Result in Table 5 shows that the constructs had adequate internal consistency. A Cronbach's alpha value of 0.70 or higher and composite reliability of 0.70 or higher recommended by Fornell and Larcker (1981) show that a construct is valid and that it has adequate internal consistency.

5.5. Convergent validity
Hair et al. (Hair et al., 2010, p. 708) recommended that standardized factor loadings of 0.50 or higher confirm the convergent validity of a construct. Table 5 shows that all the five constructs had Average Variance Extracted (AVE) >0.5, and as shown in Figure 3, all factor loadings were higher

Table 5. Constructs' internal consistency and validity				
Constructs	*No. of items/ components*	*Composite reliability*	*Cronbach's Alpha*	*Average variance extract*
First-Order constructs				
Students' satisfaction	3	0.838	0.820	0.637
Perceived progress	3	0.887	0.885	0.723
Second-order constructs				
Interactions	3 components	0.811	0.890	0.600

than 0.5 ranging from 0.63 to 0.99. Therefore, all five constructs had acceptable convergent validity.

5.6. Discriminant validity
Based on high correlations (0.838, 0.843, and 0.886) among the constructs; which indicate that they seemed to be conceptually related, we jettisoned the use of comparing squares of the correlations with the AVE to confirm the constructs' discriminant validity. Rather, we used the recommendations of Zainudin (Zainudin, 2015, p. 55) r < 0.85, Kline (2011) r < 0.90, indication of the discriminant validity of constructs. Hence, the constructs: SAT, PEP, and Interaction were accepted as distinct constructs.

5.7. Assessing normality
For this study, the data's skewness was within −1.597 to +0.014, while the kurtosis fell within −1.487 to 2.048, all were within the satisfactory limit. From Mahalanobis d-squared estimated by AMOS, just six outliers with p values <0.001 (Kline, 2011) were identified, but were included in the analysis since they were valid scores.

5.8. Structural model
figure 1 shows the relationships between the variables based on the hypotheses. A structural model to test the hypotheses was assessed as shown in Figures 4. The model fit indices show that the structural regression model approximately fit the observed data. The model explained 66.8% of the variance in the whole constructs (R^2 = 0.668). The majority (99.2%) of the covariances were <2.5, while just 0.8% was >2.5 but <4.0. For instance, only PEP35 and SCI26 have a covariance of above 2.5 with each other.

5.8.1. Model fit indice
P < 0.0001, X^2 = 194.255, df = 98, X^2/df = 1.982, GFI = 0.911, RMSEA = 0.063 (0.050–0.076), TLI = 0.956, CFI = 0.964, RMR = 0.093; SRMR = 0.0498

5.9. Hypothesis testing
Structural regression modeling was used to test all the hypotheses. The estimates were generated using maximum likelihood estimation. The results of the hypotheses are shown in Table 6. At p < 0.05, we accepted alternative hypotheses, indicating that there is a significant relationship between the exogenous variable(s) and the endogenous variable(s). Table 6 shows that interaction explained 78.3% of the variance in students' satisfaction, and 21.7% of the variance in perceived progress. Students' satisfaction explained 18.1% of the variance in perceived progress. Students' satisfaction and interaction jointly explained 75.0% of the variance in perceived progress.

Figure 4. Structural equation model.
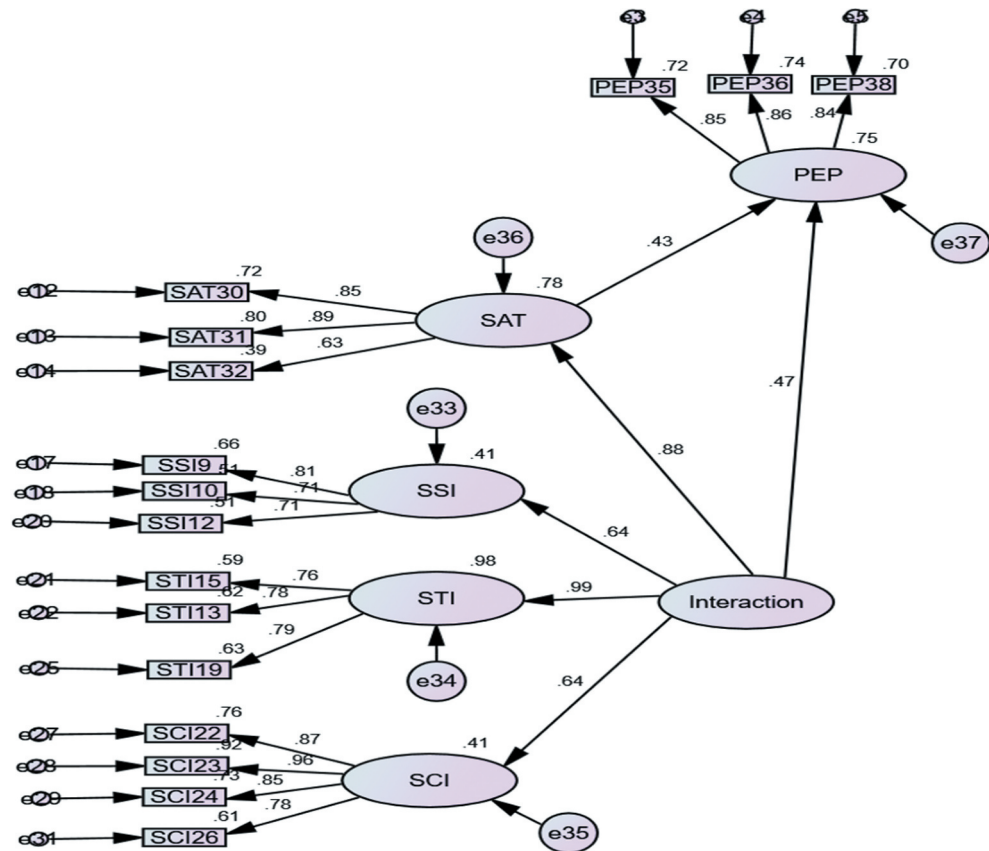
5.10. Research hypothesis 1

The results (see, Table 6) reveal a significant positive effect of the independent variable (interaction) on the dependent variable (students' satisfaction) ($\beta = 0.885$, p = 0.000). The results reveal that interaction impacted significantly on students' satisfaction and it accounted for 78.3% of the total variance in students' satisfaction ($R^2 = 0.783$). Thus, the hypothesis (H1) was accepted. This means that interaction had a significant and strong positive effect on students' satisfaction. Student–student interaction, student-teacher- interaction, and student–content interaction had loadings of 0.64, 0.99 and 0.64, respectively, on interaction which in turn had a positive relationship with students' satisfaction.

5.11. Research hypothesis 2

The results (see, Table 6) reveal a significant positive effect of the independent variable (interaction) on the dependent variable (students' perceived progress) ($\beta = 0.466$, p = 0.004). The results reveal that interaction impacted significantly on students' perceived progress and it explained 21.7% of the total variance in students' perceived progress ($R^2 = 0.217$). Thus, the hypothesis (H$_2$) was accepted. This means that interaction had a significant but moderate positive effect on students' perceived progress. Student–student interaction, student–teacher interaction, and student–content interaction had loadings of 0.64, 0.99 and 0.64, respectively, on interaction which in turn had a positive relationship with students' perceived progress.

Table 6. Unstandardised and standardised regression weight

	Hypothesised paths			Unstandardised regression				Standardised regression	SMC	Remark
				B	SE	CR	P	β	R^2	
H1	Interactions	→	SAT	2.034	0.250	8.136	0.000	0.885	0.783	Hypothesis Accepted
H2	Interactions	→	PEP	1.009	0.351	2.876	0.004	0.466	0.217	Hypothesis Accepted
H3	SAT	→	PEP	0.401	0.146	2.753	0.006	0.426	0.181	Hypothesis Accepted

Key: *SAT = student's satisfaction, PEP = perceived progress, SMC = square multiple correlation.*

5.12. Research hypothesis 3

The results (see, Table 6) reveal a significant positive effect of the independent variable (students' satisfaction) on the dependent variable (students' perceived progress) ($\beta = 0.426$, $p = 0.006$). The results reveal that students' satisfaction impacted significantly on students' perceived progress and it accounted for 18.1% of the total variance in students' perceived progress ($R^2 = 0.181$). Thus, the hypothesis (H_3) was accepted. This means that students' satisfaction had a significant but moderate positive effect on students' perceived progress.

5.13. Research hypothesis 4

Both the Baron and Kenny (1986) and the Preacher and Hayes (2004) bootstrap mediation analysis approaches were used, particularly to comprehend the relationships among students' satisfaction students' interaction, and perceived progress.

Using the Baron and Kenny's (Baron & Kenny, 1986) mediation analysis approach; once students' satisfaction entered the relationship between interaction and perceived progress, the direct effect of interaction on perceived progress decreased from ($\beta = 0.886$, $P = 0.000$) to ($\beta = 0.466$, $p = 0.004$) as shown in Figure 4. The decrease indicates that there was a mediating effect of students' satisfaction. Nevertheless, the mediation was partial because the direct effect was still significant ($\beta = 0.466$, $p = 0.004$). Therefore, in line with what we predicted, students' satisfaction mediated the relationship between students' interactions and perceived progress. Moreover, the Preacher and Hayes (2004) 5000 sample bootstrap mediation analysis was applied, if the indirect path is not significant after bootstrapping, there is no mediation; if it is significant, then there is a mediating effect. The results reveal that the indirect effect was significant ($\beta = 0.377$, $p = 0.004$); indicating that students' satisfaction mediated the relationship between students' interaction and perceived progress.

5.14. Discussion

Demographic characteristics of the respondents have provided vital information about the participants in this study. The mean age of the participants is 19.78 years. The majority of the respondents, 96.3%, were below age 46 years. The majority, 91 of them were from Veronica Adeleke School of Social Sciences. More than half, 186 (75.9%) were females. Similarly, more females (65%) participated in the study done by Lin et al. (2016). This may suggest that the female students were more favourably disposed to research. The majority 234 (95.5%) were undergraduates.

The study has shown significant positive relationships among interactions (student–student interaction, student–teacher interaction, and student–content interaction), students' satisfaction and perceived progress. This confirms the applicability of Moore's (1989) framework in a Nigerian university setting. It has been established that interactions impacted more on students' satisfaction than on perceived progress. Further findings revealed significant positive effects of student–student interaction, student–teacher interaction, and student–content interaction on students' satisfaction. Though findings of Kuo (2010), Kuo et al. (2014), and Lin et al. (2016), revealed that student–teacher interaction was not the strongest predictor of students' satisfaction, in this current study, student–teacher interaction was established to have the highest loading of 0.99 on interaction which in turn had a significant positive effect on students' satisfaction. It accounted for 78.3% of the total variance in students' satisfaction. One possible explanation for this may be the teachers' and students' readiness for online classes. It is equally possible that either the students were self-motivated for learning or that the teachers stimulated social interaction and deployed effective pedagogical strategies that motivated students' engagement in the online classes. Likewise, Borup et al. (2013) found that student–teacher interaction was a predictor of students' learning motivation, but Zhang and Lin (2019) did not find a significant positive effect of student–teacher interaction on students' satisfaction. However, student–student interaction and student–content interaction had loadings of 0.64 and 0.64 on interaction which in turn had the positive effect on students' satisfaction. Contrarily, Gray and DiLoreto (2016) found that both student–student interaction and course structure did not significantly impact students' satisfaction.

Similarly, the study has established that all types of interactions have positive effects on perceived progress. This is contrary to the findings of Lin et al. (2016) who found that only student–content interaction predicted perceived progress, and accounted for 1% of its variation. Also in variance to the findings of Gray and DiLoreto (2016), this study established that student–teacher interaction had the highest loading on interaction which in turn had a significant effect on students' perceived progress. The highest loading of student–teacher interaction on interaction which in turn had positive effects of both students' satisfaction and perceived progress may suggest good students' engagement by teachers, good teachers' interactive methodologies, teachers' feedback, and positive disposition of the majority of the students towards the majority of their teachers. Similarly, Gray and DiLoreto (2016) found that teacher's presence did significantly affect both perceived student learning and student satisfaction. Jaggars et al. (Jaggars et al., 2013, April) affirmed that it is even very crucial for teachers to actively and visibly engage with students in the virtual classes with higher intentionality than in physical classes. Therefore, it is crucial to focus on student–teacher interaction that is imperative for increased learning outcomes (Richardson & Swan, 2003). In this current study, student–student interaction and student–content interaction loaded equally on interaction which in turn had positive effect on perceived progress.

Among the students of BU, students' satisfaction had a positive effect on their perceived progress in the online class. This has extended the study done by Lin et al. (2016). Students' satisfaction with the interactions in online classes explained 18.1% of the total variance in students' perceived progress. This confirms that the level of the students' satisfaction with student–student interaction, student–teacher interaction, and student–content interaction successfully predicted their perceived progress in the online class. It means that efforts should be geared towards fostering high students' satisfaction with interactions in the online class in order to get rewarding learning outcomes. Students must derive maximum satisfaction with the virtual interaction to impact their understanding of most of the content in the class, communication skills, and increased opportunities for collaborative activities after the class, among others. According to Eom et al. (2006), students' satisfaction is a predictor of learning outcomes. Though Lin et al. (2016) did not examine the mediating effect of students' satisfaction on the relationship between the interaction and perceived progress, a striking finding is that this current study has established that students' satisfaction mediated the relationship between students' interactions and perceived progress.

We identified the following limitations of this study that need to be considered by future researches. First, our study was carried out in only one university, which probably makes impossible the generalizability of our findings to other universities. Second, the study model was tested with small population. Thus, the study model should be tested with a larger population. Moreover, our study only focused on students from BU, and since Jiang et al. (2021) also found that online learning satisfaction was moderated by regions, it would be better to recruit all students from different universities (both private and public) in other regions of Nigeria to examine the moderating effects of regions, and as well examine whether student–teacher interaction will still have the highest loading on interaction to predict students' satisfaction and perceived progress in online learning environments.

Furthermore, this study only examined the effect of one variable (i.e., students' interactions) on satisfaction and perceived progress. However, there must be many other variables/factors. For instance, Jiang et al. (2021) found that online learning satisfaction in higher education was influenced by computer self-efficacy, perceived ease of use and perceived usefulness. We recommend further studies to include more potential factors, such as social factors (Mates et al., 2021) in the model to account for more total variance in satisfaction and perceived progress.

5.15. Conclusion
In this study, empirical evidence has shown that Moore's (1989) framework explained variances in students' satisfaction and perceived progress. The research model has adequately explained and established the relationships among students' interactions (student–student, student-teacher, and

student-content) on students' satisfaction and perceived progress in the online class, and that students' satisfaction significantly mediated the relationship between students' interactions and perceived progress. Thus, in interactions enriched virtual environments, once students' satisfaction is promoted, this congruously impact on students' understanding of content, the development of critical thinking and communication skills, and the willingness to participate in future collaborative activities.

This study contributes to the corpus of knowledge on the effect of interaction in the online university education, and extends it by establishing the mediating effect of students' satisfaction in the relationship between interaction and perceived progress. Our results suggest that an increase in student–teacher interaction is highly beneficial to both students' satisfaction and perceived progress. Student–teacher interaction having the highest loading on interaction which in turn had positive effect on both students' satisfaction and perceived progress, as found in this study, points to the fact that university lecturers should play significant multiple roles as initiator, motivator and moderator of student engagement in the online classes. Enacting communication rules and expectations as regards interactions, giving the students collaborative activities to work on as a group, and motivating them to interact in the most positive way; should be part of the pedagogical, managerial, and social roles of the lecturers.

Moreover, the improvements in student–content interaction will likely result to increase students' satisfaction and perceived progress. The university management can improve student–content interaction by appropriate infrastructural development, technology optimization, networking, and increased collaboration. Furthermore, providing explanations for the design of a course can go a long way to improve student–content interaction. Online instructors should strongly consider the use of best practices on content-related methods of engaging students in an online class (Lin et al., 2016). Such should include: building contents based on students' interests, using student-centered methodologies, systematically organizing and designing content, entrenching deadlines within the content structures, and communicating the content through diverse media (DiPietro et al., 2008).

The emergency of online teaching and learning triggered by the COVID-19 pandemic has proved the efficacy of technologies in facilitating interactive learning without boundaries and the university authority may have to consider the adoption of hybrid learning, which incorporates both traditional and online learning systems.

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The data for this study will be made available to researchers on request.

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