Work-In-Progress: Liberian Undergraduate Engineering Students' Perceptions of the Impact of COVID-19 on their Learning Experience

Collins N. Vaye

Collins N. Vaye is a first-generation college student and a native of Liberia, West Africa. Currently, he is a 3rd year Engineering and Computing Education Ph.D. student at Florida International University. His research interests revolve around: –Effective Technology Integration in Engineering Education. –Faculty Development, Professional Development, and Technology Supported Learning. –Broadening Participation in Engineering and Engineering Technology within and from Sub–Saharan Africa.

Precious Chukwuweike Eze (Mr)

Bruk T Berhane (Assistant Professor of Engineering Education)

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Vaye, Collins N; Eze, Precious; Dr. Berhane, Bruk

Abstract

The massive disruption to the global education system caused by the COVID-19 pandemic has garnered educational research communities' attention by illuminating the need to investigate the pandemic's immediate and long-term effect on education. However, less is known about its impact on engineering education in developing countries such as Liberia.

Guided by the Technology Acceptance Model (Davis and Bagozzi, 1989), our research is the first step in understanding Liberian engineering students' perception of the impact of COVID-19 on their learning experiences. This work-in-progress paper presents preliminary results from 3 of the 18 participants of this study.

This study focuses on the impact of the abrupt transition from face-to-face to online learning due to COVID-19 and particularly on undergraduate engineering students' learning experiences at a public university in Liberia. The research design employed to achieve this goal is a qualitative phenomenological research approach using semi-structured interview methods.

Findings from our study reveal a potential two-fold challenge that needs to be addressed: Psycho-social challenges and technical challenges. Our future work will unpack these and other challenges across the other 15 participants in the study.

Keywords: COVID-19, Online Learning, Student Experience, Engineering Education, Sub-Saharan Africa, Technology Acceptance Model

Introduction

The World Health Organization (WHO), in January 2020, declared the coronavirus (COVID - 19) a global pandemic and reported that the virus was first detected in Wuhan, the capital of Hubei Province, China [1]. Since then, COVID-19 has become a household name worldwide, and its disruptive effects have impacted all sectors of society. COVID-19 has been compared to other major pandemics throughout history, such as the Spanish flu, Smallpox, novel influenza, and the Ebola virus [2], [3]. However, the pandemic's scale of impact and its level of disruption throughout the world have been overwhelmingly devasting. For instance, COVID-19 has been considered the greatest global health calamity of the century and has the most significant challenge humankind has faced since World War II [4]. Within weeks, COVID-19 led to unprecedented health and socio-economic crises, leading to the loss of human life [5]-[7]. As of January 28, 2022, WHO has recorded 364,191,494 confirmed cases of COVID-19, with a total of 5,631,457 deaths globally [8]. Africa has recorded eight million-plus confirmed cases in the same period, including 163,532 deaths, as shown in figure 1 [8].
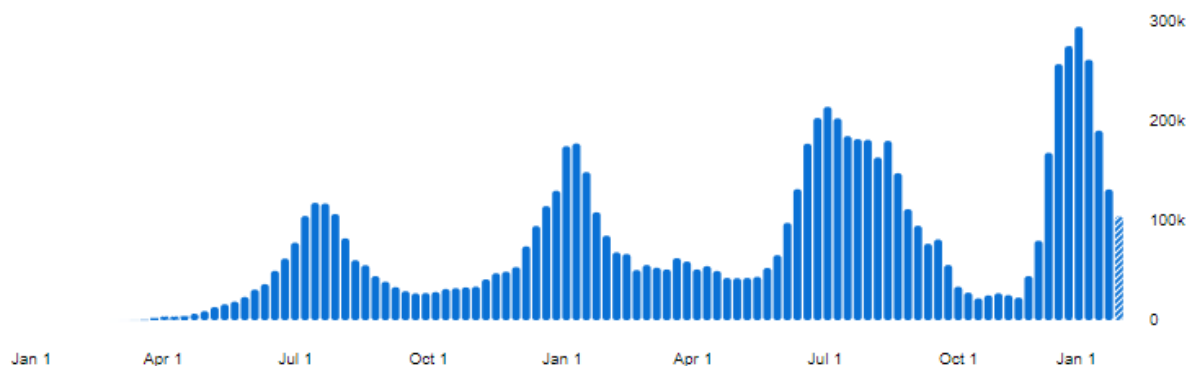

Figure 1: Total Confirmed Cases in Africa

Source: WHO Coronavirus (COVID-19) Dashboard https://covid19.who.int/ Accessed: 1/28/2022.

On March 16, 2020, the National Public Health Institute of Liberia (NPHIL) recorded the first confirmed COVID-19 case in Liberia, making Africa's oldest republic the 27th African country formally affected by the pandemic [14]. From January 3, 2022, as shown in Figure 2, WHO has reported a total of 7,254 confirmed COVID-19 cases in Liberia, including 290 deaths. Unfortunately, COVID-19 is the second pandemic in half a decade to disrupt the Liberian education system and other sectors. In 2014, Liberia and its neighboring countries (i.e., Sierra Leone and Guinea) were significantly impacted by the deadly Ebola epidemic. The Ebola crisis

spread rapidly in all counties in Liberia and devastated the nation's economy. In total, more than 3600 people died from Ebola in Liberia between 2014 and 2015 [15], [16].
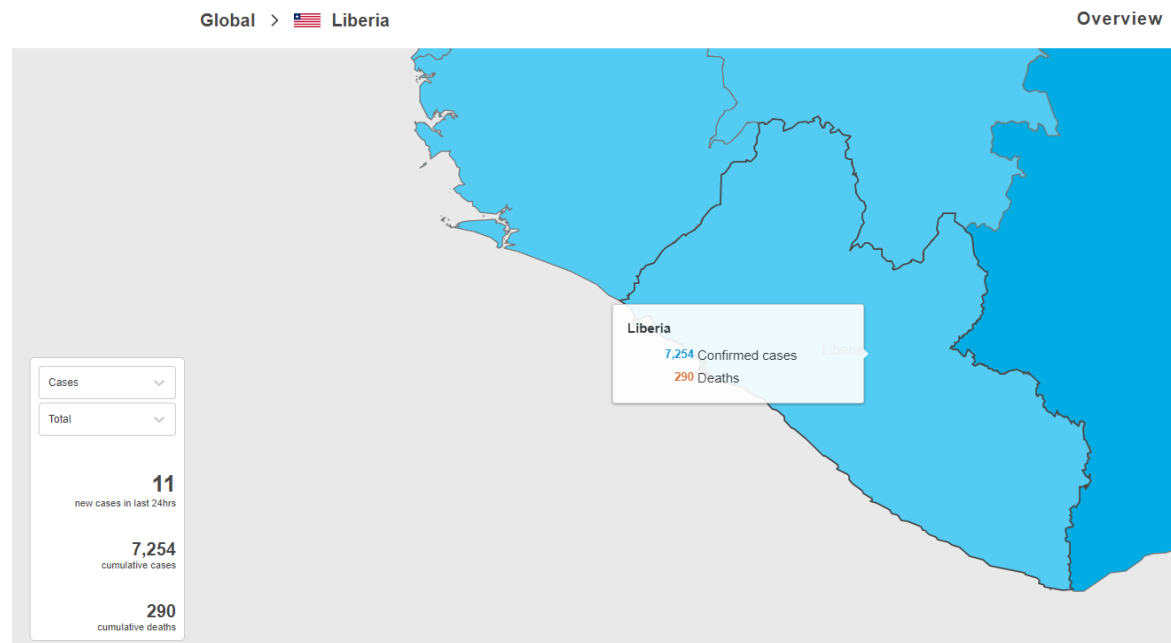

Figure 2: Total Coronavirus Cases in Liberia Source: WHO Coronavirus (COVID-19) Dashboard https://covid19.who.int/ Accessed: 1/5/2022

Following the government's precautions in the face of COVID-19, in March 2020, all schools in Liberia closed their doors to traditional face-to-face learning. A survey of 1049 Liberians responding to COVID-19 showed that about 64% perceived the pandemic as a problem for Liberia, and 90% supported the closure of schools [17]. However, the closure of schools created anxiety amongst Liberian students, many of whom were greatly affected by the deadly Ebola epidemic years earlier [15]. The extent to which the Coronavirus pandemic has impacted education, especially science and engineering education, in Liberia, a country recovering from the shocks of the Ebola epidemic, is still unknown. This paper is a first step towards understanding the challenges of COVID-19, specifically on undergraduate engineering education in sub-Saharan Africa, with a specific focus on Liberia. In particular, our research will explore and document undergraduate engineering students' perceptions of how COVID-19 impacted their learning experiences as they transitioned to online learning in Liberia.

In 2020, the United Nations reported that the COVID-19 pandemic had caused enormous disruptions to global education systems, affecting nearly 1.6 billion learners in more than 190 countries [9]. Students pursuing careers in disciplines like science and engineering, where in-person laboratory experiences are valuable to their preparedness for jobs in the industry, have been impacted severely by the disruption of COVID-19 [10], [11].

Following the unprecedented disruptions caused by the pandemic, governments of many countries took several extraordinary measures, including the closure of schools, public

gatherings, large and small businesses, social distancing, and campaigns to build health awareness, in order to prevent the spread of the COVID-19 pandemic [4], [6], [7], [9]. Moreover, as in-person learning ended for many schools, many transitioned to virtual learning [5], [6], [10], [12]. The closures of schools and other learning spaces have impacted 94% of the world's student population and up to 99% in low and lower-middle-income countries including, Liberia, a developing country in Sub-Sharan Africa [6], [13].

The massive disruption to teaching and learning in schools across the world as a result of COVID-19 has illuminated the need to investigate the pandemic's immediate and long-term effect on education [18]. However, less is known about its impact on undergraduate engineering education in developing countries, such as Liberia, as most recent investigations have focused on the United States and Europe [10]-[12]. With this paper, we hope to contribute to the ongoing research studies on the impact of COVID-19 on engineering education [5], [10], [12]. Most notably, it will help fill a gap in the literature with respect to the locus of these studies, by focusing on an understudied region of the world, namely, sub-Saharan Africa.

This paper is especially relevant given the demographics of sub-Saharan African countries like Liberia. It is also relevant given the trends across education in general and within engineering education in particular in this part of the world. In sub-Saharan Africa, where 47% of the world's out-of-school children live [13], COVID-19 has exacerbated an already tenuous education situation. Before COVID-19, many developing countries in sub-Saharan Africa faced many challenges in promoting engineering education [19]. For instance, prior research studies outlined the following key factors: lack of engineering capacity, shortage of engineering technicians, mediocre quality and relevance of educational provision, lack of human and financial resources, and poor linkages with industry [19], [20]. In addition, scholars have pointed to the low level of computer literacy, broadband penetration, high costs of information and communications technology (I. C. T.) support devices, and internet access in developing countries in Africa [21]. This has made it challenging to deploy online teaching and learning. Like many sub-Saharan African countries, online education is not widely available in Liberia. In fact, following the closure of schools during COVID-19, many universities and community colleges remained closed for the duration of the nationwide lockdown. The latter was mainly due to the high cost of deploying virtual learning management systems. However, a few universities deployed online learning for the first time to complete the second half of the 2019-2020 academic year. Foregrounded by this recent history, our study's findings will unpack the experiences of undergraduate engineering students at a public university in Liberia during their transition to online learning in June 2020.

The results of this study have the potential to inform the international education research community, governments within and outside of sub-Saharan Africa, higher education stakeholders, and non-government organizations (NGOs) as they address the impact of COVID-19 on engineering education. Understanding engineering students' perceptions of how COVID-19 influences engineering education will provide relevant information for educational recovery plans and inform the way engineering curricula are designed to prepare students for unexpected challenges.

Research Objectives

This research aims to:
(1) Understand Liberian undergraduate engineering students' perspectives about the impact of COVID-19 on their learning experiences.
(2) Examine these students' perspectives of factors affecting the teaching or learning of engineering courses delivered via a virtual learning management system in Liberia.

Research Questions

The following primary (and sub) research questions guide our study:

- What has been the impact of COVID-19 on Liberian undergraduate engineering students' learning experiences?
  - What were the barriers impacting these students' learning experiences as they transitioned to virtual learning due to COVID-19?
  - What institutional or individual factors did students report having facilitated their transition to online learning during COVID-19?
  - How did these engineering students perceive the virtual learning system's ease of use and usefulness in delivering engineering courses?

Theoretical Framework.

This research is guided by the technology acceptance model (TAM) developed by Fred Davis and Richard Bagozzi in 1989. TAM is "an adaptation of reasoned action (TRA) theory specifically tailored for modeling user acceptance of information systems." [22]. Precisely, TAM is best known for investigating factors affecting user acceptance of information systems [22]-[24]. It has shown immense potential to explain and predict a user's behaviors and reactions to information communication and technology [23]. Since its inception in 1985, TAM has been tested with various applications (e.g., learning management systems, health information systems, mobile application enterprise resource planning) [25]. Additionally, TAM has become the most widely applied user acceptance model and usage model [22], [23], [26].

The TAM framework presents three critical constructs [22] [23]: *perceived ease of use (PEOU), perceived usefulness (PU), and attitude towards using the system* [22]. Scholars suggest that these three constructs are factors that explain a user's motivation for using an information system. Given the above and our research objectives, we propose TAM as the most preferred model to explore Liberian undergraduate engineering students' perceptions of and intention to use a virtual learning platform. Precisely, this research will focus on TAM's two critical components: perceived ease of use (PEOU) and perceived usefulness (PU) to explore the students' perception of the virtual learning platform.

- PU refers to the user's perception of the system's usefulness, which will improve their task performance [22].
- PEOU refers to the extent to which users believe that the system usage would be free of effort [22].

The model attempts to explain some reasons why some individuals or groups choose to use a particular technology and states that they do so because they find the technology practical and easy to use. For the first time, a public university in Liberia, where our study is situated, deployed an online learning management system, Moodle, to complete semester II of the 2019-2020 academic year. Hence, in this study, we will focus on the students' PEOU and PU related to the Moodle learning management system in delivering engineering classes. In addition, the study will also explore other external variables, barriers, and supports that influenced their behaviors and intentions to accept the online learning platform during COVID-19.

Researcher Positionality

Positionality statements are extremely useful in engineering education, as they offer researchers the chance to deeply explore their own personal beliefs, broader worldviews, and fundamental motives [27]. Scholars add that one method of providing a positionality statement is by *establishing transparency of self-attributes* [27]. Establishing this kind of "transparency" can involve researchers sharing demographic, financial, academic, or other information about themselves [27]. The benefits of these types of positionality statements include the removal of bias and that they help ensure the trustworthiness of the data. Building on this foundation, we offer the following positionality statement:

The first author was born in and received his primary, secondary, and initial post-secondary education (bachelor's degree) in Liberia. His bachelor's degree is in electrical engineering, and his master's degree is in computer engineering. He also attended Metropolitan University (MU, a pseudonym), the site for this study, where he actively volunteered to assist with multiple STEM education efforts. This also afforded him the chance to work closely with staff, faculty, and administrators at MU. The second author was born in and received his primary, secondary, and initial post-secondary education (bachelor's degree) in Nigeria. His bachelor's degree is in chemical engineering, and his master's degree is also in chemical engineering. Both the first and secondary authors received their master's degrees outside of their home countries, in the U.S. (first author) and in South Africa (second author). In addition, the first and second authors are enrolled in Ph.D. programs in the U.S. in engineering and computing education are motivated to improve engineering and other STEM education throughout the continent of Africa through their research.

The third author is the advisor to the first and second authors. His education was completed entirely in the U.S. and has earned electrical engineering (bachelor's), engineering management (master's), and doctoral degrees (education). His research is generally focused on broadening participation in engineering through U.S. community colleges and transfer pathways. However, he is also motivated to find new and innovative ways to broaden participation in engineering within sub-Saharan Africa.

Research Design

The purpose of this research is to explore Liberian undergraduate engineering students lived academic experiences related to the impact of COVID-19 as they transitioned to online learning. To unpack the full depth of their experiences, our design employs a qualitative approach, using phenomenology as the primary research methodology. A phenomenological research study is an appropriate method for this research as it can provide an in-depth understanding of the nature of a particular phenomenon [28], in this case, the *lived experiences* of engineering students during COVID-19.

Process
In this phenomenological study [29], we interviewed engineering undergraduate students at the Metropolitan University (MU, pseudonym) in Liberia via Zoom and in person.
In order to recruit participants, the primary author utilized a combined approach that involved reaching out to staff and administrators, as well as a snowball sampling approach. First, the primary author leveraged his prior academic and professional working relationship with staff members and administrators of the College of Engineering at MU. The staff and administrators provided direct connections to a number of students. In particular, they created online recruitment flyers, which were then distributed via social media platforms (Facebook Messenger, WhatsApp) accessible to students at the College of Engineering. In addition, hard copies of the advertisement were sent to the College of Engineering's administrative office to be posted on campus for students who might not be able to see the electronic invitation. As students began responding to this initial solicitation, additional respondents were recruited via snowball sampling.

Snowball sampling allows researchers to recruit more participants into a study by starting with a smaller number of participants and relying on this smaller number to engage others in their own familial, social or professional network [30]. This approach has been found to be particularly useful with marginalized populations. In the case of this study, given the impact of COVID-19 on in-person learning and challenges that staff/administrators have had in actively engaging students, it was particularly useful to have student participants build on their own social networks to recruit other students that may have not been as responsive to staff/administrator outreach.

Study Site and Population
Our study is situated in the College of Engineering at MU in Liberia. As mentioned early, online learning is not widely deployed in Liberia, given several educational disparities. However, a few public and private universities, including MU for the first time in Liberia, deployed the Moodle learning management system and other online learning platforms and transitioned to online learning during COVID-19.

IRB/human subjects approval was granted for this study. Every participant was provided with a $25.00 gift card for their participation. A total of thirty 30 students signed up via the online recruitment process to participate in the study. However, eighteen (18) participants actually completed the consent form and were eligible to participate in either online or in-person interviews after completing our online demographic survey. The online learning semester at MU was regarded as the "Special E-Learning Semester" since it was the first of its kind.

In order to facilitate the recruitment of student participants, a faculty member in the Department of Electrical Engineering was asked to help identify possible interviewees. This faculty member also was able to help arrange meeting locations, recruitment flyers, and other logistics related to the study. In summer 2022, this faculty member will be provided a small consultant fee to recognize his efforts on the project.

Data Collection
The primary data collection method for this study was a semi-structured interview method. The Semi-structured instrument is preferred as an appropriate interviewing format for this qualitative research because in-depth data can be extracted through it [31]. Participants have the opportunity to answer predetermined questions related to the study in an open-ended manner [31]. In Summer 2021, the lead investigator traveled to the campus where MU is located and conducted thirteen (13) individual interviews and two (2) focus groups. (We acknowledge Dr. Eunsil Lee (Virginia Tech) for her support and guidance in developing the interview protocol for this study.) The semi-structured instrument is preferred as an appropriate interviewing format for this qualitative research because in-depth data can be extracted through it [31]. Participants have the opportunity to answer predetermined questions related to the study in an open-ended manner [31]. In Summer 2021, the lead investigator traveled to the campus where MU is located and conducted thirteen (13) individual interviews and two (2) focus groups as detailed in Table 1. The focus groups involved a total of five students, for a total of 18 students.

Interview and Focus Group Data Collection		
	Individual Interview	**Focus Group**
Total	13	2
In-Person	9	2
Online	4	N/A
Minimum Duration	28 Minutes	50 Minutes
Maximum Duration	44 Minutes	60 Minutes

Table 1: Interview and Focus Group Data Collection

Data Analysis
Given the qualitative nature of this research, interview and focus group data collected from the study participants were analyzed using thematic analysis methods. The goal of thematic analysis is to identify themes, i.e., patterns in the essential data, and use these themes to address the

research or say something about an issue [32]. The primary and secondary authors did an initial analysis by looking at the Zoom transcripts. We looked for emerging themes relating to barriers, supports, persistence, COVID-19, and school closure, and we developed sub-themes. We further discussed with our advisor, the third author on this paper, some of the emerging themes. In addition, the primary and secondary authors had several additional discussions in which we converged on the initial themes that we present in this paper. Therefore, this work-in-progress paper will highlight the initial evidence from the first three (3) students out of the eighteen (18) total participants. Our future manuscripts will explain the themes across all eighteen (18) participants and illuminate ways in which their perspectives converged with or diverged from other outcomes in existing literature.

Findings

Our research seeks to understand *the impact of COVID-19 on Liberian undergraduate engineering students' learning experiences as they transitioned to online learning.*
We begin this section by presenting findings from our demographic survey for all 18 participants. Of the 18 participants, thirteen identified as men and five identified as women. Each of the 18 students registered for at least two engineering classes during the Special E-Learning Semester, as shown in Figures 3 and 4, respectively. The College of Engineering at MU has five departments: Civil, Electrical, Geology, Mining, and the newly established Mechanical engineering department, Figure 5. Our participants represented all but the newly established Department of Mechanical Engineering. About 62% of our participants were senior students with a minimum of two courses left before graduation presented in Figure 6. When asked about their online learning experiences before COVID-19, 61.1% of the participants mentioned they had not had any online learning experience before, as shown in Figure7.

After we present this figure below, we then provide an overview of the research findings from interviews with the three students we interviewed for this work-in-progress paper. We chose these three students in particular because their transcripts were the most readily available at the time of this paper.

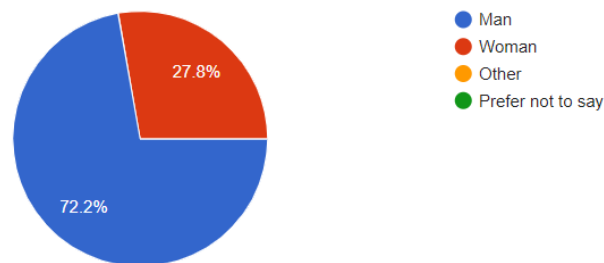

What is your current gender identity?

18 responses

Man
Woman
Other
Prefer not to say

27.8%

72.2%

Figure 3: Gender Data

Demographic Information on Study Participants

How many of your registered classes were engineering ?

18 responses

- One
- Two
- Three
- Four
- Five or All

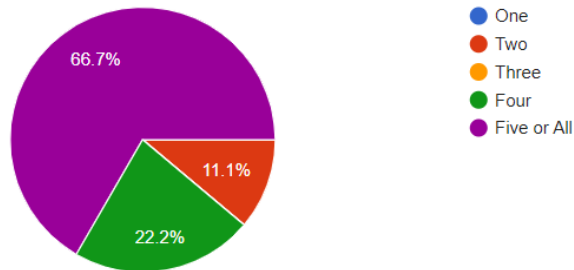*Figure 4: Number of registered engineering classes during the e-learning semester*

What is your current class standing?

18 responses

- Freshmen
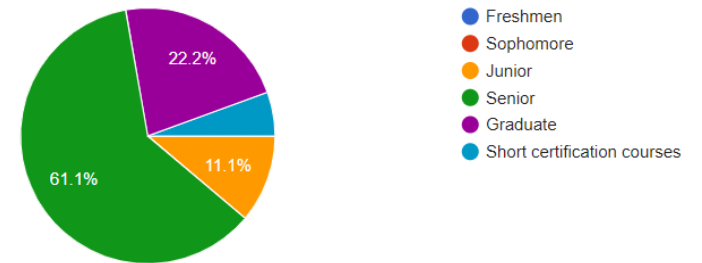- Sophomore
- Junior
- Senior
- Graduate
- Short certification courses

Figure 5: Students' Status

What degree field are you currently pursuing or (did you pursue)?

18 responses

- Civil Engineering
- Electrical Engineering
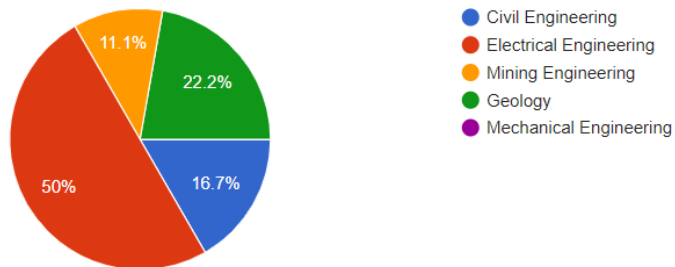- Mining Engineering
- Geology
- Mechanical Engineering

Figure 6: Departments at College of Engineering, MU

Have you had any experience with online classes prior to the COVID-19 pandemic?

18 responses

- Yes, I have taken classes in the past that were fully online
- Yes, I have taken online courses from online platforms (Ex: Cousera; LinkedIn Learning ...)
- Yes, I have taken some hybrid classes (partly online; partly in person)
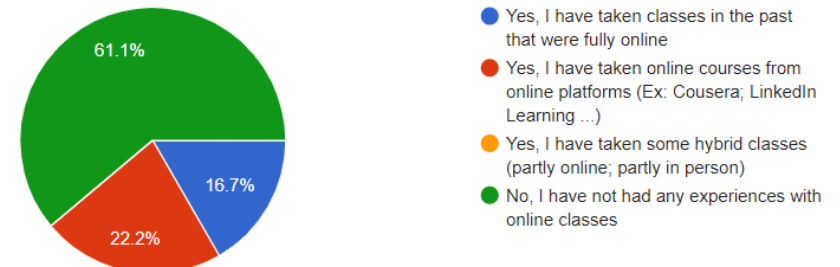- No, I have not had any experiences with online classes

Figure 7: Online Learning Experiences before COVID-19

Barriers in transitioning to online learning

Initial findings from the interview indicated that the three students experienced some level of difficulty while transitioning to online learning. For instance, Luckier, a geology senior in MU, cited the high cost of internet data, insufficient electrical power supply, and lack of the required internet-ready devices as the biggest challenges he faced during his transition to online learning. The insufficient power supply was specifically a major source of concern. In describing the challenge, Luckier said, "Once you do not have current, you are out of school for the day be it Zoom meetings." Flomo, the second student and a civil engineering senior at MU also shared a similar view. He identified a lack of technical expertise in using online learning tools as one of the challenges affecting his ability to transition to online learning. When asked about the biggest challenge impacting his ability to learn online, he stated that it was the high cost of internet data. In his words, "that was the most challenging very well because in my family we need data and to purchase the data was not an easy thing". Daniel, the third candidate who is also a senior at MU, mentioned the poor internet reception in his location as a major obstacle while transitioning to online learning. This led to occasional interruptions during online classes. Secondly, his environment was always noisy and it made it difficult for him to focus during classes. Thirdly, he did not have a reliable smart device at the early stage of the transition. In his words; "The phone I had at the start was not too advanced to meet the requirements for e-learning".

Readiness

The students identified various factors that impacted their readiness in transitioning to online classes. Luckier explained that being computer literate prepared him for the transition to some extent. In his words, "I have computer knowledge so I was able to attend all of my classes successfully and make sure that with a little data package, I was able to complete my classes." On the other hand, Flomo explained that he experienced anxiety and stress at the start of online classes due to the lack of movement which impacted him and his family negatively. Additionally, the school experienced an academic delay at the start of the pandemic and it pushed his graduation date forward, thereby causing him emotional stress. The concept of remote learning was strange to Daniel because it was entirely new in his institutional setting, however, he saw it as a great opportunity to learn, and that made him mentally prepared. However, Daniel stated that he felt some anxiety because the COVID-19 pandemic set his academic journey and expectations back due to the academic delay. In his words, "It delayed my time in school because I planned to leave school at a particular time due to my short-term goals and my long-term goals". He also mentioned that the inability to interact physically with his peers impacted him negatively at the start of the online class.

Institutional and personal sources of support.

The interviews revealed that the students were primarily supported by their families during their transition to online learning. For instance, Luckier mentioned that there was no financial support from the university to acquire resources like a computer, internet data, and study materials. Initially, the university promised to assist students with some money to facilitate their online learning. According to students, however, MU did not provide these financial resources Luckier explained, "I was able to maneuver to get myself online" .with support from family and close friends. Flomo stated that the institutional support was limited to the provision of course materials online and training on how to use the online learning platform. Referring again to the financial resources that students stated were never provided, Flomo added that he then had to find other funds to support his learning. In his words, "It was my own private laptop I used". Since the pandemic affected his ability to work, he had to rely on financial support from family and friends while learning online. Daniel, the third student, also cited a poor level of institutional support. He explained that the university initially promised to collaborate with telecommunication companies in providing internet data for students but reneged on their promise. Just like Luckier and Flomo, he had to rely primarily on family support to study online.

Persistence

The students identified several factors that helped them stay motivated amidst the challenges they faced while transitioning to online learning. Luckier was able to stay motivated because of the ease that came with accessing his class remotely. In the past, he would have to travel several miles to attend classes, which he described as challenging. However, the introduction of online classes eliminated that problem. Flomo maintained motivation due to the ability to access course materials once he had internet data. He explained, "Although it was difficult to get the data, but when I have the data, I will access my notes. That is the most good thing that was motivating me. I purchase data and I get what I want". Similarly, Daniel was able to stay motivated because of the promise of a bright future that can be achieved by completing his studies. The emotional and financial support from his family and friends also kept him motivated.

Perception of online learning

Concerning the students' perceptions of online learning, Luckier appreciated the opportunity that online learning offered. He explained, "One can always refer to an online lecture and rewatch the video to get more clarity, unlike the traditional class setting." He also raised the issue of technical difficulties associated with Moodle (the online learning system). It experienced occasional malfunctions, and there were some instances in which he experienced difficulties while submitting his assignments. However, Luckier maintained that online learning is a viable and cost-effective solution compared to traditional learning. Flomo was also optimistic about

learning online despite the challenges he experienced during his transition. He explained that delivering the lessons online through video recordings or notes enabled him to read and watch them at any time. This was a preferable method to attending classes in person. He was also able to save money from accessing course content online rather than printing them when attending classes in person. In terms of the effectiveness and usefulness of Moodle in delivering the engineering courses, Daniel stated, "if I were to rate it out of 10, maybe I'd say 5 out of 10." He admitted that there were technical challenges with some of the features of the platform, which occasionally disrupted the progress of the online class.

Discussion and Future Work

While scholars have unpacked themes related to the impact of COVID-19 on education, very few studies have been conducted within sub-Saharan African contexts [21][, [31],[35], [36]. This work-in-progress paper offers an initial exploration into the factors that both helped facilitate and well as impede students' learning. As a small qualitative study, we recognize that not all results may apply to future studies on this topic. However, our research begins to explore engineering education in particular in a type context that has been largely overlooked by scholars within our discipline.

Indeed, scholarships that have emerged in engineering education about the current pandemic often focus on anxiety, motivation, and other psycho-social domains [33], [34]. These types of domains notwithstanding, our initial evidence reveals that parallel to these concerns is the issues of technology itself. In other words, while students in other studies [4], [10]-[12], [31] may be concerned about the stress of being online and not in person, undergraduates in this work had to deal both with that issue *and* concerns over access to technology and internet access. Thus, there is a potential two-fold challenge that needs to be addressed: Psycho-social challenges and technical challenges. Concerning the technical challenges faced by students in developing countries, recent studies have shown that online learning cannot produce the desired results since the majority of students in these countries are unable to access the internet due to technical as well as monetary issues [36], [37]. These studies are consistent with our preliminary findings. Despite the Psycho-social and technical challenges, participants in the study viewed the transition to online learning as an opportunity to learn and meet their time to graduate.

Our future work will unpack these and other challenges across the other 15 participants in the study. In addition, future research will explore the extent to which students – as some listed here – felt supported by the institution, their families, or others. The theme of *support* is one that can offer more of an asset-based perspective even as we document challenges that students faced. To be sure, our goal is to address COVID-19 challenges while also focusing on opportunities within Liberia and across sub-Saharan Africa.

Appendix A: Participants' Demographics information

No.	Pseudonym	Department	Gender	Age	Online Learning Experience before COVID-19
1	Luckier *	Geology	Man	34	No
2	Karledo	Electrical Engineering	Man	21	Yes
3	Musa	Electrical Engineering	Man	27	No
4	John	Electrical Engineering	Man	24	No
5	Saye	Electrical Engineering	Man	26	No
6	Beckie	Civil Engineering	Woman	25	No
7	Hawa	Civil Engineering	Woman	21	No
8	Daniel *	Electrical Engineering	Man	25	No
9	Peter	Geology	Man	27	Yes
10	Jerry	Electrical Engineering	Man	26	No
11	Nyan	Mining Engineering	Man	29	Yes
12	Flomo *	Civil Engineering	Man	40	Yes
13	Yah	Geology	Woman	25	No
14	Mary	Geology	Woman	29	Yes
15	Paul	Electrical Engineering	Man	28	Yes
16	Joskie	Electrical Engineering	Man	27	Yes
17	Loius	Mining Engineering	Woman	28	No
18	Alex	Electrical Engineering	Man	24	No

* Initial findings from the participant are discussed in this work-in-progress paper.

Appendix B: Code Book

Liberian Engineering Education Research Codebook	
Assessments	Low-quality assessments
Leadership	Poor Budget and planning
	Corruption/mismanagement
	Monitoring standards
	Policies/political situation
	Low provincial standard
Infrastructure	Distance/Online learning
	Internet
	Inadequate technology/facilities
	Poor equipped laboratories
	Absence of local codes
	Shortage of personal computers
	Inequity (Digital divide across states/countries)
Financial Support	Domestic Philanthropists
	Digital Entrepreneurs
	Educational financing
	Poor funding
	High tuition costs
Human Capital	Brain-drain
	Shortage of human capacity
	Poor staff training
	Poor retention profiles
Teaching	Defective Curricula
	Disruption of school curriculum
	Traditional teaching style
	Quality (High-quality educators)
	Blended-modular learning

Reference

[1] "Statement on the tenth meeting of the International Health Regulations (2005) Emergency Committee regarding the coronavirus disease (COVID-19) pandemic," *www.who.int*. https://www.who.int/news/item/19-01-2022-statement-on-the-tenth-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-coronavirus-disease-(covid-19)-pandemic.

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