UNIVERSITÀ DEGLI STUDI DI PADOVA
Dipartimento Territorio e Sistemi Agro-forestali
Department of Land, Environment Agriculture and Forestry

Corso di laurea magistrale/Second Cycle Degree (MSc)
in Forest Science

Impacts of COVID-19 Pandemic on teaching and learning Forest Science in Africa and Europe: Lessons learned from case studies

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ANNO ACCADEMICO/ACADEMIC YEAR 2021/2022

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Table of Contents

List of figures

List of tables

List of Annex

List of abbreviations and acronyms

AU	Africa
COVID-19	Coronavirus disease
EU	Europe
FAO	Food and Agriculture Organization of the United Nations
Ha	Hectare(s)
IFSA	International Forestry Students' Association
ITTO	International Tropical Timber Organization
UN	United Nations
UNFF	UN Forum on Forests
UNICEF	United Nations Children's Fund
WHO	World Health Organization

AU is used to refer to responses from African universities, while EU refers to responses from European universities.

Acknowledgement

*And **the Lord was with Joseph**, and he was a prosperous man...* – Genesis 39:2 (KJV).

My first and utmost appreciation goes to God almighty for giving me the priviledge to be admitted and awarded two scholarships to study Erasmus Mundus Master Programme in Mediterranean Forestry and Natural Resources Management (MEDfOR), at the University of Lleida, Spain and the University of Padova, Italy between October 2020 and October 2022. I glorify God for seeing me through my Master's degree and giving me strength to face the challenges that comes my way to providing me opportunities. All wisdom comes from God, and He graciously grant me to write this thesis. May the name of my Lord and Savior, Jesus Christ be praised (Amen).

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The scripture said *"God raiseth up the poor out of the dust, and lifteth the needy out of the dunghill; That he may set him with princes, even with the princes of his people"* (Psalm 113:7-8). I am thankful for the opportunity to have served as IFSA's Head of Forest Europe Sub-commission (2021-2022); and Coordinator, Joint IUFRO-IFSA Task Force on Forest Education (2019-2021) and impact the lives of many other students through various activities I have contributed to. During my studies, I have published 13 publications including a book, studied with 5 European universities, attended over 25

webinars and 3 face-to-face meetings in 3 countries ,and spoke to several audiences. I was a Dare to Explore Trainee at the European Forest Institute, Germany. I also contributed to the organisation of several conferences, meetings, or webinars among many other opportunities. Thank you, Lord, for the upliftment and opportunities.

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My sincere apologies to those I may have mistakenly omitted their names or acknowledged their roles. I am grateful.

English Summary

The forestry sector was not spared from the impacts of the COVID-19 pandemic, and the way forest education is delivered in response to lockdowns and reduced mobility. The aim of this study is to investigate the impacts of the COVID-19 pandemic on the teaching and learning of forest science in Africa and Europe. Countries purposively selected in Africa include Nigeria and Uganda Italy and Spain were selected in Europe were selected in Europe. Eleven universities were also purposively sampled for the study in these countries. For the data collection, a well-structured and pre-pre-tested questionnaire was administered electronically via emails, and WhatsApp messages to students and academic staff. The questionnaire complied with the General Data Protection Regulation (GDPR) and was approved by the University of Padova on 14.09.2021. The collected data was analyzed using Microsoft 365 Excel. The total number of responses received and analyzed for the study was 238, of which 23 (9.66%) were lecturers and 215 (90.34%) were students. Many of the responses, 192 (80.67%) were from African universities, and this can be attributed to the high population of students studying forestry in Africa. The results show that the use of virtual teaching has increased in forest science, as well as in other higher education due to the COVID-19 pandemic, and universities' policies are adapting by providing more flexibility and a variety of teaching methods. Zoom was the most popular platform used for online video conferencing during the pandemic. Most of the students watched online class recordings to compliment the online teaching. The top general challenges faced by students and lecturers during the pandemic were missing the interactions they used to have with their colleagues and lecturers before and after lectures; and missing going on field trips or visits. Most students and lecturers did not communicate the challenges they faced in online learning and teaching to their respective universities. The COVID-19 pandemic has helped the students enhance their soft skills such as collaboration, working in a team, use of ICT tools, etc. as well as combining studies and work. In the same vein, the lecturers had access to use of new tools and teaching approaches; although the use of virtual teaching tools made it mandatory for teachers/professors to be innovative and learn new techniques, software, and skills. Unfortunately, it was discovered that both forestry students and lecturers currently do not appreciate the use of virtual reality (VR) to replace fieldwork. the European respondents feel that the quality of forest education provided during the COVID-19 pandemic was compromised, as there were usually more field trips than are currently obtainable. The overall perspective of learning and teaching forest sciences in the COVID-19 pandemic era is more negative for the students, while it is half positive and half negative for lecturers. I recommend that forestry degree curriculum at universities should be flexible to allow addition of new topics, use of variety of teaching and assessment methods, in a blended approach of face-to-face and online. The integration of technologies should lead to more flexibility of studies, a reduction in tuition fees and attract more young people. The exchange of lecturers and students between African and European universities offering forestry programme should be explored as they are in high demand by the respondents. There is also a need for integration of diversity of professionals from other nationals in teaching of forestry as all lecturers who responded to the survey are nationals of the respective countries where the university is located.

Italian Summary

Il settore forestale non è stato risparmiato dagli impatti della pandemia COVID-19 e dal modo in cui l'educazione forestale viene impartita in risposta alle chiusure e alla mobilità ridotta. Lo scopo di questo studio è indagare l'impatto della pandemia COVID-19 sull'insegnamento e l'apprendimento delle scienze forestali in Africa e in Europa. I Paesi selezionati in Africa includono Nigeria e Uganda, mentre in Europa sono stati selezionati Italia e Spagna. Anche in questi Paesi sono state selezionate in modo mirato undici università per lo studio. Per la raccolta dei dati, un questionario ben strutturato e pre-testato è stato somministrato elettronicamente tramite e-mail e messaggi WhatsApp a studenti e personale accademico. Il questionario è conforme al Regolamento generale sulla protezione dei dati (GDPR) ed è stato approvato dall'Università di Padova il 14.09.2021. I dati raccolti sono stati analizzati utilizzando Microsoft 365 Excel. Il numero totale di risposte ricevute e analizzate per lo studio è stato di 238, di cui 23 (9,66%) erano docenti e 215 (90,34%) studenti. Molte delle risposte, 192 (80,67%), provenivano da università africane, e ciò può essere attribuito all'elevata popolazione di studenti di scienze forestali in Africa. I risultati mostrano che l'uso dell'insegnamento virtuale è aumentato nelle scienze forestali, così come in altri settori dell'istruzione superiore, a causa della pandemia COVID-19, e le politiche delle università si stanno adattando fornendo maggiore flessibilità e una varietà di metodi di insegnamento. Zoom è stata la piattaforma più utilizzata per le videoconferenze online durante la pandemia. La maggior parte degli studenti ha guardato le registrazioni delle lezioni online per integrare l'insegnamento online. Le principali sfide generali affrontate da studenti e docenti durante la pandemia sono state la mancanza delle interazioni che erano soliti avere con i colleghi e i docenti prima e dopo le lezioni e la mancanza di gite o visite. La maggior parte degli studenti e dei docenti non ha comunicato alle rispettive università le difficoltà incontrate nell'apprendimento e nell'insegnamento online. La pandemia COVID-19 ha aiutato gli studenti a migliorare le loro competenze trasversali come la collaborazione, il lavoro di squadra, l'uso degli strumenti TIC, ecc. e a conciliare studio e lavoro. Allo stesso modo, i docenti hanno avuto accesso all'uso di nuovi strumenti e approcci didattici; anche se l'uso di strumenti didattici virtuali ha reso obbligatorio per gli insegnanti/professori essere innovativi e imparare nuove tecniche, software e competenze. Gli intervistati europei ritengono che la qualità dell'istruzione forestale fornita durante la pandemia COVID-19 sia stata compromessa, poiché di solito le escursioni sul campo erano più numerose di quelle attualmente possibili. La prospettiva complessiva dell'apprendimento e dell'insegnamento delle scienze forestali nell'era della pandemia COVID-19 è più negativa per gli studenti, mentre è per metà positiva e per metà negativa per i docenti. Raccomando che il curriculum di studi forestali nelle università sia flessibile per consentire l'aggiunta di nuovi argomenti, l'uso di una varietà di metodi di insegnamento e di valutazione, in un approccio misto di lezioni frontali e online. L'integrazione delle tecnologie dovrebbe portare a una maggiore flessibilità degli studi, a una riduzione delle tasse universitarie e ad attrarre più giovani. Dovrebbe essere esplorato lo scambio di docenti e studenti tra le università africane ed europee che offrono programmi forestali, poiché sono molto richiesti dagli intervistati. È inoltre necessario integrare la diversità dei professionisti di altre nazionalità nell'insegnamento della silvicoltura, dato che tutti i docenti che hanno risposto al sondaggio sono cittadini dei rispettivi Paesi in cui si trova l'università.

Tradotto con www.DeepL.com/Translator (versione gratuita)

Chapter 1: Introduction

Forests cover approximately 31.2% of the land area on earth in 2020 (FAO & CPF, 2022). Forests have been known to provide numerous benefits, such as contributing to economic and job creation (FAO & CPF, 2022); human health through forest fruits and foods (FAO, 2020a); biodiversity conservation, soil and water protection, and social services such as recreation, tourism, education (FAO, 2020d); and providing green forest jobs that provide decent work and contribute to sustainable forest management SFM (FAO & UNECE, 2018). Last but not least, the ability of forests to contribute to healthy economic and environmental recovery from the severe impacts of the COVID-19 pandemic, as the world will need a healthy planet for a healthy economy, the need for more renewable materials, and building inclusive, resilient, and sustainable economies (FAO, 2022b; UNDESA & UNFF, 2021). It should be noted that the COVID-19 pandemic influences forests and the forestry sector, as well (Stanturf & Mansuy, 2021).

As the world continues to acknowledge the goods and services derived from forests and forestry, there will always be a need to produce more professional foresters (Gabay & Rekola, 2019). Forests are also essential to achieve Goal 4 of the Sustainable Development Goals (SDG): Quality Education (Kanowski et al., 2021). In fact, the cross-impact of forests and the entire SDGs have led to the development of voluntary global forest goals and targets (UNFF, 2019).

The work of a professional forester is changing beyond the management of forests but in the collaboration and leadership of other workers in the forestry and other sectors. The need to improve education to vocational level to promote decent working conditions in forests is being promoted, especially in tropical forests. In fact, we need a better understanding of the informal forest sector, which represents 75% of people working in the sector (Lewark, 2022).

The COVID-19 disease was declared a pandemic by the World Health Organization on March 11th, 2020, forcing countries to close their borders and restricting movement by imposing lockdown. Schools, offices, universities, and all public places were closed (Sobral et al., 2021; UNICEF, 2021; WHO, 2020).

Several studies and surveys related to the COVID-19 pandemic and online teaching / learning have been carried out at different scales around the world. Studies often survey students and their teachers with varying focus and results. Some of the studies include; the evolution and effectiveness of online teaching/learning (Jegede, 2020; Narayanan, 2020; Shyju et al., 2021); students (un)willingness to use

their camera during online video classes (Bedenlier et al., 2021; Castelli & Sarvary, 2021); students' concerns about their future career and professional life (Al-Ansi, 2021; Aristovnik et al., 2020; Petruzziello et al., 2022); student advisors (Moosa, 2021); student assessment (Ajagbe et al., 2021); students belonginess (Tice et al., 2021); students mental health (Chen & Lucock, 2022); and the entire higher education system (Alatni et al., 2021; Filho et al., 2021; Khaoula & Jalal, 2021; Pypenko et al., 2020; Sultanova et al., 2021).

There are not as many studies on the use of online teaching in forest science which began more than two decades ago. One of the first reports from universities in Germany and South Africa about the piloting of online teaching of forest science to students (Längin et al., 2004). With the advent of the COVID-19 pandemic, few studies have been carried out, ranging from studying student-lecturer perspectives on the effectiveness of virtual teaching in forest sciences (Mushkarova et al., 2020; Ratnasingam et al., 2020). Students and instructors' perspective of teaching and learning *'forest operations',* which is a fully practical field course (Dodson & Blinn, 2021; Tereshchenko et al., 2020). Another study investigated how the course delivery was modified by the instructors of 'forest operations' (Dodson & Blinn, 2022). It has also been established that some projects/institutions have reported the wider-scale, larger-scale adoption of e-learning to reach many students (Rodríguez-Piñeros et al., 2020). Recent research in forest education has not documented the impact that e-learning can have on forestry graduates.

In many African countries, schools were closed for several months due to factors such as inability to transition online, poor quality, and high cost of the Internet, among others (Anifowoshe et al., 2020; Isah et al., 2021). However, in Europe, many countries and more than 95% of their universities could easily transition online to ensure their students' continuous education (Cutri et al., 2020; European University Association, 2020).

1.1 Justification of the thesis

The result of a student undergoing a tertiary education is to increase their knowledge, develop their abilities, skills, and competencies to allow them to fit for the job market or create their own jobs. Forest education is being transformed day by day through improvement in curriculum and teaching methods (Kanowski, 2020; Muncharaz et al., 2015).

Many forestry lecturers worldwide are now researching the effectiveness of curriculum and teaching methods used and how they can impact the future career of their students. Discrepancies between employer needs and skills developed by universities are apparent; It is also becoming increasingly

expensive to deliver higher education in forest science and the use of educational technology is encouraged (Jegatheswaran et al., 2018; Kelly & Brown, 2019; Zeng et al., 2020).

The role of universities in responding to extreme events has been acknowledged (Masiero et al., 2021). However, universities need to transform their forestry curriculum to reflect new topics such as the link between ecosystem health and human health, the importance of biodiversity for the planet's stability, the impacts of the social and economic inequalities on the resilience of communities, the role of green areas on human well-being, etc. (Ameyaw et al., 2019; de Jong et al., 2021; E. Wilson, 2022).

Beyond the adaptation of the forest curriculum to new important topics, there is a knowledge gap on the impacts of virtual teaching and learning forest science during the COVID-19 pandemic on students and lecturers in universities from developed countries in Europe and developing countries in Africa.

The researcher focused on perspectives on virtual teaching before and during the COVID-19 pandemic; challenges faced, experienced, and communicated by students and lecturers relating to virtual teaching/learning, prospects of online teaching of forest sciences in a post-COVID-19 pandemic world, and future impacts that could be experienced by lecturers, students, and graduates. This research focus, target audience, and methodology are novel, possibly the first of its kind to be carried out. Therefore, this study contributes to scientific knowledge on this important research on forest education and the COVID-19 pandemic.

1.2 The objectives of the thesis

The main aim of the study is to assess the impacts that COVID-19 pandemic had on teaching and learning forest science in universities in Europe and Africa with the view to making recommendations that can improve teaching and learning in the future. The specific objectives of the study are;

1. To understand how virtual or blended teachings were carried out by forest science teachers in the selected universities before and during outbreak of COVID-19 pandemic.
2. To explore the challenges faced by students in learning and teachers in teaching of forest science during the COVID-19 pandemic in the selected universities.
3. To explore the perceived prospects of online teaching and learning of forest science post COVID-19 pandemic in the selected universities.
4. To explore the perspectives of teachers and students on the lasting impacts that teaching and learning forest science in COVID-19 pandemic area could have on future careers of students.

1.3 Structure of the thesis

This thesis is written as primary research where the author collected its own data. The thesis is structured in five chapters. Chapter one provides an introduction to the thesis, the justification of the study and the objectives of the thesis. Chapter two reviews similar, and relevant literature on COVID-19 pandemic, and how it affects forestry and tertiary education. Virtual teaching is explained, its challenges and connection to forest education. Review of forest education and background on selected countries was carried out too. Chapter three provides a comprehensive description of the methodology followed during this study, and assumptions and limitations of the results. Chapter four provides the result and discussion, the authors interpret the data, shares his thoughts, and corroborates his arguments with sufficient scientific studies. Chapter five provides a conclusion , recommendations from the study, and suggested further research topics.

Immediately after the references, an annex section was provided. Annex A provides the questionnaire for the study; Annex B is the email communications; and Annex C provides supplementary information and data.

Chapter 2: Theoretical Background

2.1 Introduction

This chapter contains the main concepts discussed in this thesis by conducting background research and synthesizing the information as it will help to better understand the topic. This chapter is subdivided into five sections. Section 1 described the COVID-19 disease and the COVID-19 pandemic; Section 2 provided an introduction to virtual teaching and learning and provides an overview of virtual teaching and learning in forest science; Section 3 provided a brief glimpse of recent studies related to forest education globally; and Section 4 provided background information on forest education in selected continents and countries.

2.2 Description of COVID-19 disease and the COVID-19 pandemic

Coronavirus disease is defined by the World Health Organization (WHO) as *'Coronavirus disease (COVID-19) is an infectious disease caused by the SARS-CoV-2 virus'.* It goes further to describe the symptoms as experiencing mild to moderate respiratory illness and recovering without requiring special treatment. However, some will become seriously ill and require medical attention. People with underlying health conditions and older people will be severely affected. It also mentioned that the disease can affect people of any age and can cause death. It recommended the practice of hygienic practices, hand sanitization, physical distancing, use of facial masks, and getting vaccinated (WHO, 2022a).

On 11 March 2020, the COVID-19 disease was declared a ***pandemic*** by WHO, through a media briefing. The declaration was required due to the level of spread of the spreading disease and the severity of its impacts. There were already more than 118,000 cases of COVID-19 in 114 countries, and 4,291 people have lost their lives by the time a pandemic is declared (WHO, 2020).

In WHO's own words,

"...WHO has been assessing this outbreak around the clock and we are deeply concerned both by the alarming levels of spread and severity, and by the alarming levels of inaction. We have therefore made the assessment that COVID-19 can be characterized ***as a pandemic.*** *Pandemic is not a word to use lightly or carelessly. It is a word that, if misused, can cause unreasonable fear, or unjustified acceptance that the fight is over, leading to unnecessary suffering and death... We have never before seen a pandemic sparked by a coronavirus.* ***This is the first pandemic caused by a coronavirus****. And we have never before seen a pandemic that can be controlled, at the same time. WHO has been in full response mode since we were notified of the first cases. And we have called every day for countries to*

take urgent and aggressive action. We have rung the alarm bell loud and clear."- (WHO, 2020)[1]. Emphasis that of the author.

2.1.1 COVID-19 pandemic infections, death, and vaccination

According to WHO, at 7:18pm CEST, 26 July 2022, there have been 568,773,510 confirmed cases of COVID-19 have been reported worldwide, including 6,381,643 deaths. A total of 12,248,795,623 vaccination doses have also been administered (WHO, 2022b). More than 55% of the global population has been vaccinated, thus helping to reach herd immunity and could lead to lower mortality rate. In terms of global trends, the morbidity and mortality of COVID-19 has continued to decline. The average cumulative case fatality of COVID-19 at 7 days decreased from 12.3% on February 25, 2020, to 0.27% on January 09, 2022. This could be related to a decreased virulence of the SARS-CoV-2 variant, vaccine immunization, and/or better treatment of patients (Zhou et al., 2022).

On a regional basis, as of July 2022 Africa has over 8 million cases, over 170,000 deaths reported in 47 countries in the WHO Africa region (WHO Regional Office for Africa, 2022), while there are almost 209 million cases, and over 2 million deaths in the WHO European Region (WHO Regional Office for Europe, 2022).

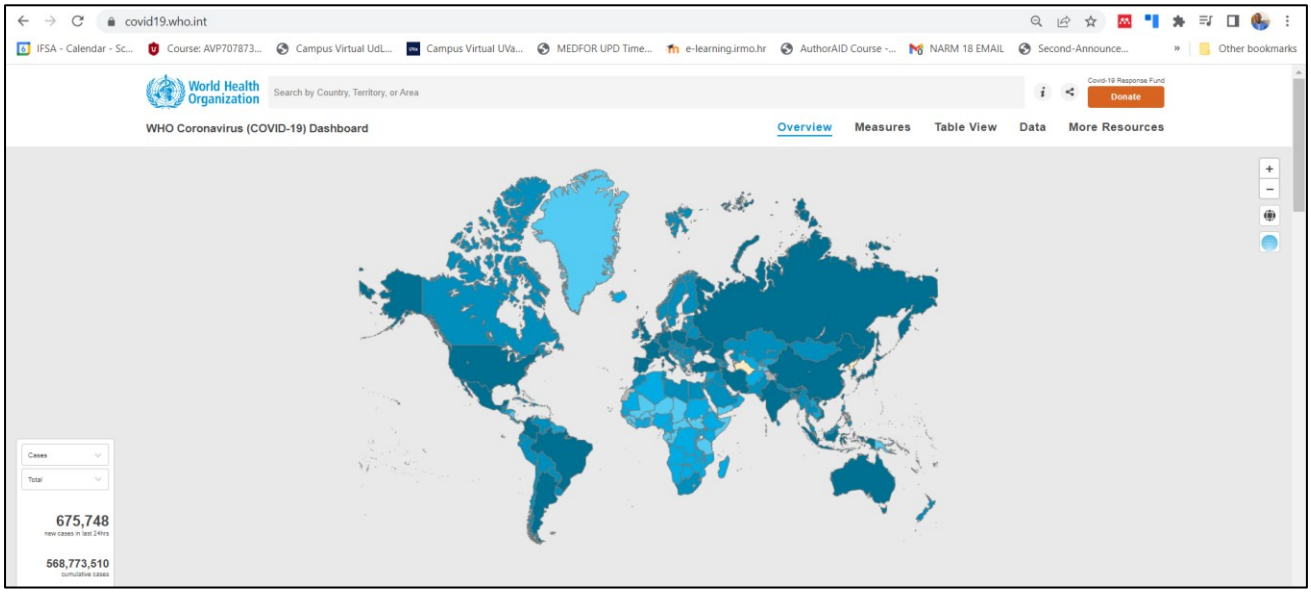

Figure 1: WHO COVID-19 dashboard
Source: WHO, (2022b)[2].

[1] https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-COVID-19---11-march-2020 (Accessed July 27, 2022).

[2] https://covid19.who.int/ (Accessed July 27, 2022).

2.1.2 COVID-19 pandemic and forestry

As the COVID-19 pandemic ravages and affects all aspects of life and society in general, the forest sector is not immune to it. The forest sector has also been impacted by the pandemic, some in good light and others in a negative way.

On the positive side, the COVID-19 pandemic has highlighted the importance of urban forest to provide natural social and psychological support to its users in Freiburg, Germany, as people were allowed to visit nature sites during the toughest of the lockdowns (Weinbrenner et al., 2021). On a global scale, the forestry sector contributed to the economy recovery and the sector was able to bounce back quickly to preCOVID-19 period (FAO, 2022b). Opportunities also exist for the transmission of forest and environmental information such as zoonotic diseases and better management of biodiversity to avoid future infectious diseases and pandemics (UNEP, 2020).

However, COVID-19 caused more negative impacts for forests in the United States of America and Canada through delayed or postponed forest management and research, the increase in the number of visitors to forests near urban areas increased vandalism, garbage accumulation, and the danger of fire ignition. Forest tourism was reduced, affecting local communities among other challenges (Stanturf & Mansuy, 2021). The pandemic caused economic loss in the forest sector in Nepal (Laudari et al., 2021); increased deforestation and threats to biodiversity in Bangladesh (Wunder et al., 2021); increased illegal logging in southern Africa (Chirwa et al., 2021); nature-based tourism was negatively impacted, and illegal logging increased in Nepal (Maraseni et al., 2022); and created a considerable potential for loss of income in wood-based products in Turkey (Komut, 2022).

On a general note, there was also an increase in the number of households that use wood fuel to cook because the pandemic and lockdowns push people into poverty. There was an increase in deforestation rates in 2020 but FAO argued that this cannot be attributed to the pandemic (FAO, 2022b). Forest also provides an opportunity to build a better and greener future (UNEP, 2021). The pandemic also requires a growing interest in the nexus between forest and human health, such as income, recreation, medicine, nutritious forest foods and psychological support (FAO, 2020a).

2.1.3 COVID-19 pandemic and tertiary education

One of the earliest and immediate responses of countries to the COVID-19 pandemic is the closure of their borders and going on full lockdown, although the effectiveness of this method is still debatable

in science (Emeto et al., 2021). Shiraef et al., (2022) found no evidence in favor of international border closures, whereas found a strong association between national-level lockdowns and a reduced spread of SARS-CoV-2 cases. On the other hand, a positive Pearson correlation between mobility and COVID-19 spread was observed based on analysis of data from four countries with high infection rates, that is, Australia, Germany, The United Kingdom and The United States of America (Al-Jubory & Al-Shamery, 2021). Tertiary education has been able to safeguard the lives of its students and lecturers by transitioning online and being flexible in delivering quality education (Bin et al., 2021).

In Rwanda, for example, a survey of 1,170 students in 30 institutions shows that the pandemic has caused disruptions of the academic calendar, suspension of examinations, and students being unable to conduct research and undergo internships. Students' learning quality and the ability to learn from their peers were hindered due to social distancing with those in rural areas and those from vulnerable families were worst affected (Twesige et al., 2021). In Nigeria, a study warned that if care is not taken, continuing the closure of universities due to the COVID-19 pandemic without any participation of the students can lead to them dropping out of their study (Abosede et al., 2021).

2.2 An introduction to virtual teaching and learning

At the beginning of April 2020, 98.4% of the world's student population was affected by lockdowns (Nasir, 2020). Lockdowns in countries also forced schools including universities to be closed from in-person teaching and learning to transition online (Adeyanju, Ajilore, et al., 2022). How this affects education differs from one country and regions to the other, those especially hit is developing countries where health and education systems are not well developed (Khaoula & Jalal, 2021). In Nigeria, public institutions were not prepared to transition online immediately, as poor internet infrastructure and unstable electricity supply were some of the challenges identified (Adeyanju, Ajilore, et al., 2022; Hassan et al., 2021; Udem et al., 2021).

In India, universities transitioned rapidly with admission, lectures and exams conducted online to protect the life of the students and teachers. However, the ill-timed implementation of a new education policy with the intent of transferring the role of higher education to the private sector has worsened the situation (Singh & Chander, 2020). Students and lecturers in private universities in Nigeria preferred the use of online examination mode as a means of testing, as almost 100% of 904 respondents are aware and familiar with electronic examination platforms (Ajagbe et al., 2021).

The COVID-19 pandemic also gave universities with already designed online learning an opportunity to test their capacities in transitioning quickly. For example, it took only two business days for Northern Michigan University, United States of America, to move 98% of all classes to virtual as they already have an online campus system on the ground that was used for long-distancing education (Ngafeeson, 2021). The switch to virtual teaching can in the long run offer more flexibility for students, reduced tuition fees, reduced recruitment costs, and possibly increase the diversity of enrolments to students who traditionally are not able to attend higher education (Dennis, 2021).

Several suggestions for improvement to enable universities to meet quality and standard in delivering online education, such as an upgrade of technological infrastructure (Hassan et al., 2021; Khaoula & Jalal, 2021); provide pedagogical training for teachers on the use of an online platform (Beytekin, 2021; Khaoula & Jalal, 2021; Montenegro-rueda et al., 2021); building of campus wide e-learning agenda including appropriate infrastructure and professional development for the future (Leiba & Gafni, 2021); students assessment should be focused on continuous assessment rather than on exams as it provides a more qualitative way to assess at a distance (Montenegro-rueda et al., 2021); and further research on the topics of digital learning and teaching is still needed (Bond et al., 2021).

Mogaji & Jain, (2020) conceptualized idea on the impact of the pandemic on higher education in emerging countries, see Figure 2. The authors suggested some topics worth exploring regarding higher education such as perspectives of the university as an institution, parents, staff, and students. This study focused on the students and staff and explored some of the questions suggested by the authors.

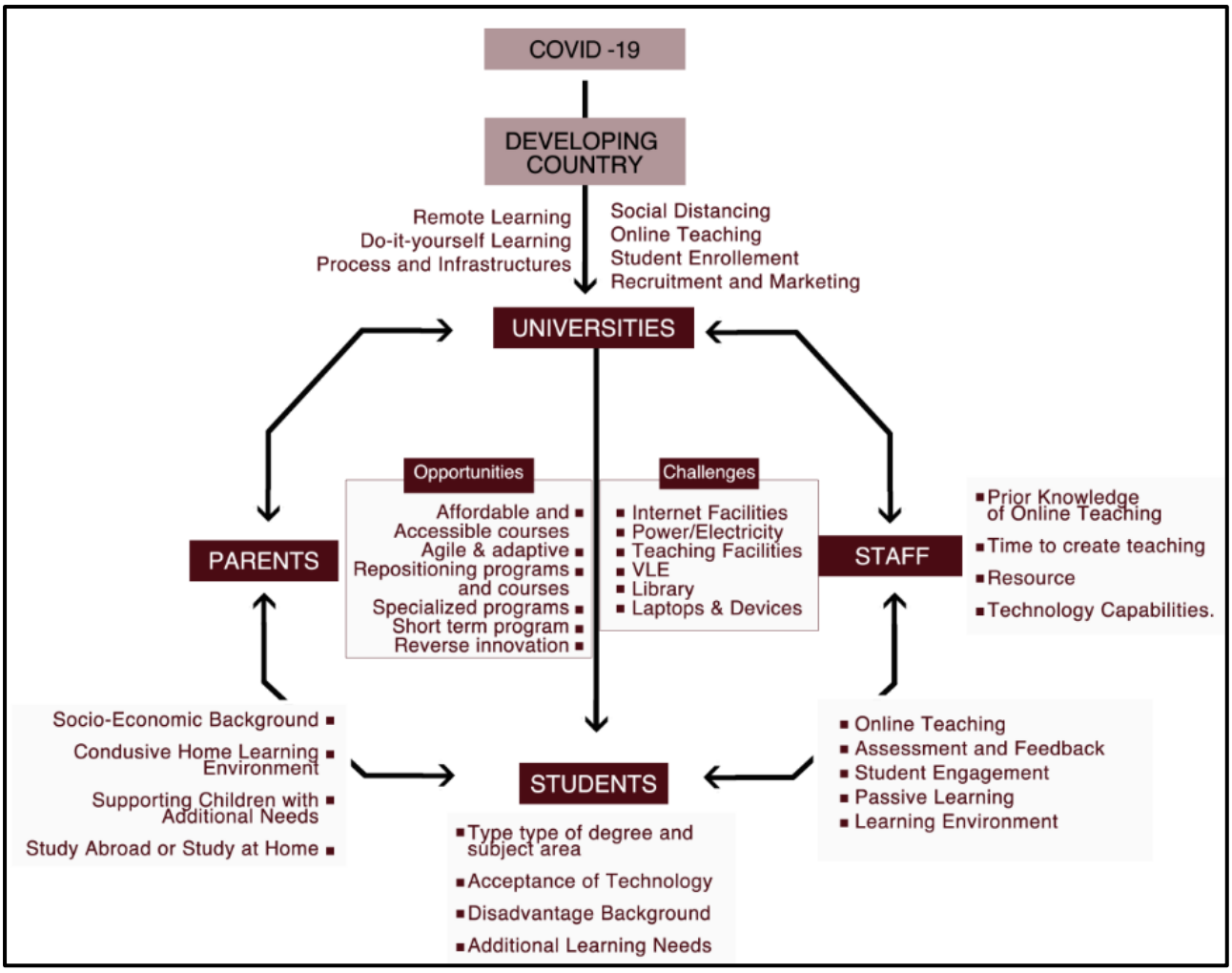

Figure 2: A Conceptualization of the Impact of the Pandemic on Higher Education in Emerging Countries
Source: Mogaji & Jain, (2020).

2.2.1 The downside of virtual teaching and learning

In every opportunity lies some challenges, and the use of virtual teaching and learning methods are not immune to this. Some of the challenges are provided below.

- **Unstable Internet connection:** The quality, stability, and cost of Internet has been a recurrent issue discussed in research on virtual teaching and learning. Students in rural areas are more affected where the Internet signal may not be strong enough (Al-Hashmi, 2021)

- **Stress and anxiety:** More than 50% of 1173 students at one University in the North of England reported a high level of anxiety and depression beyond clinical cut offs, with females experiencing it higher than males in an online survey. These problems can be lessened or worsened by individual student personality characteristics (Chen & Lucock, 2022). On a global

level, more students are socially isolated and have general anxiety about COVID-19 disease (UNESCO, 2020).

- **Engagement and belongingness:** A study explained that the data from the national student survey in Australia highlighted a significant drop in student participation and their sense of belonging due to the pandemic. It concluded that belonging is important for students' success and instructors should try a mix of methods to improve online students' engagement such as less long video lectures, creation of informal discussions, reshuffling of discussion group, etc. (Tice et al., 2021). Other studies also highlight students feelings of loneliness (Chattaraj & Vijayaraghavan, 2021), and how we might be losing our human connections, feelings, and emotions (Gibbs, 2020).

- **Ethical and privacy concern:** A study of faculties in Israel shows that one of the concerns of lecturers is the intrusion of privacy through cameras and microphones at home (Leiba & Gafni, 2021). In a German study, on average students are not comfortable using their webcam as they fear others might be privy to their privacy and they do not know how others might perceive them (Bedenlier et al., 2021).

- **Cost of ICT deployment:** Inadequate funding is the top priority of the list on the challenges faced by public higher institutions in the Nigeria in deployment of ICT facilities to meet the COVID-19 pandemic (Jacob et al., 2021). Universities will now need to balance investments in physical buildings for face-to-face teaching and upgrading their digital facilities in a post-COVID-19 pandemic education era (Oginni et al., 2021).

- **Internalization of education hampered:** The reduced mobility and closure of international borders have an impact on internationalization of education in terms of students and scientists to be able to travel abroad for study, research, or conference purpose (Erhan & Gümüş, 2020).

- **Challenges in assessment** It has been reported that a key challenge faced by faculty in the wake of online teaching is on how to assess their students, as most exams were conducted face-face and on paper earlier. In a US study, chemistry students performed 12 to 25% better than the pre-pandemic semester when all activities are face-to-face (Kolack et al., 2020). Some students engage in dishonesty practices during online assessment to obtain higher grades, universities adapted by monitoring student examinations over video calls. In general, more students prefer to write face-to-face exams (Montenegro-rueda et al., 2021; Sobral et al., 2021).

2.2.2 Virtual teaching and learning in forest science

One of the earliest examples of delivering forest education is documented by Längin et al., (2004), documenting how forest education was delivered online in Germany and South Africa. For example, in the 2000s, University of Freiburg, Germany began by hosting a few online studies to serve as self-study and meet the knowledge gap of first-year forestry students. By July 2003, it already collaborated with the University of Stellenbosch, South Africa, to provide two-week online studies for forestry students at the Freiburg and Eastern European faculties.

An initiative from the Faculty of Forestry at the University of British Columbia found that - *"appropriately integrating educational technologies into an internationally developed and recognized high-quality curriculum is an effective way to create accessible and affordable forest education in meeting the demand of evolving social and environmental conditions."* (Zeng et al., 2020). Wood Science and Technology in Malysia, which is largely a technical course and taught in person, also had to adapt to the virtual teaching mode (Ratnasingam et al., 2020).

A study from Saint Petersburg State Forest Technical University, Russia shows that forest education is also moving gradually expanding from just e-learning to mobile learning with the popularization of education platforms that can be accessed on mobile phones/tab as it provides a new pedagogy opportunity. It can also increase student interest and motivation in their studies (Tereshchenko et al., 2020). Another study from the same university concludes that forest managers believe that the integration of distance learning methods in forestry higher education institutions will improve the quality of human capital, increase labour productivity, and the efficiency of using forest resources (Mushkarova et al., 2020).

In the wake of reduced field activities, forest students are taking learning beyond their local area and countries when they enroll for free online courses offered by international organizations, e.g., FAO 'Forests and Transparency under the Paris Agreement' (https://elearning.fao.org/local/search/infocourse.php?id=746). Students also learn from their peers through networks such as the International Forestry Students' Association (IFSA) (FAO, 2022a). In fact, forestry students are also co-developing knowledge and making it available for their peers such as the TreE-Learning (https://ifsa.net/tree-learning/) created by IFSA which is a platform for students to broaden their horizon (Onatunji, 2022).

Beyond students, universities are also adapting to the COVID-19 pandemic in teaching forest science. For example, the Scottish School of Forestry which offers a lot of technical-oriented courses have to encourage their faculty members to upscale their digital skills as blended approach of learning are used. The lecturer goes to the forest to make video recordings and students are also encouraged to do so after carrying out a task in the forest (Hendrie, 2021). Blended teaching has also been suggested as an opportunity to improve forest education in the United Kingdom (E. Wilson, 2022).

2.2.3 Challenges related to virtual teaching and learning forest science

In America, both students and faculty struggled with the transition to online learning for forest operation courses/modules, and limited success was found through course modifications such as field lab activities, asynchronous content delivery, and modified learning expectations (Dodson & Blinn, 2021). A follow-up study shows that teachers will need to broaden their digital skill sets and resources, and there is a renewed appreciation of field experiences. Employers should also anticipate further field training for new employees who were educated during the pandemic (Dodson & Blinn, 2022).

Research from Malaysia shows that Wood Science and Technology students face connectivity problems (computer hard disk and internet) and communication problems. The lecturers acknowledge that most of the technically inclined topics in wood science cannot be effectively taught online as students are required to work in the laboratory (Ratnasingam et al., 2020).

2.3 Short look at recent studies relating to forest education worldwide

In 2015, there are 95 forestry graduates per 1 million ha of forests worldwide (331, 000 forestry students graduated in 2015) and the number of women now accounts for approximately 33% of all graduation same year. It is also acknowledged that forest managers of the future are likely to require a wide range of skills to perform their jobs successfully (FAO, 2020d). It should be noted that these are based on official data reported to FAO and could be significantly higher in reality as in the case of forest-related employment reported by Lippe et al., (2021).

Forest education is moving forward globally and rapidly, so those who are engaged in forest research and education for development will need to be politically and institutionally astute and proactive and strategic, in catalyzing and pursuing opportunities (Kanowski, 2020). Attraction of diverse-age students still remain challenging in the United States for example, as most of them are not aware of career opportunities in forestry until after matriculation in college (Burmann et al., 2022). In Romania,

research shows that factors such as expected academic results, gender, family, socioeconomic status will affect the ability of forest students to complete or drop out of their studies (Cocoradă et al., 2021).

It has also been reported that despite a tremendous amount of progress in forest education worldwide, the progress has been uneven in certain regions of the world. Progress includes review of curricula to help professional foresters develop skills that are in sync with society and industry needs. Continuing forest education is encouraged at the master's and doctoral level (de Jong et al., 2021).

2.4 Forestry education background of selected continents and countries

This subsection attempts to provide a background to forest education in the countries selected for this study. To start with, a bachelor's degree takes three years to complete in Italy, Spain, and Uganda, while it takes five years in Nigeria. The curriculum differs from country to country and programs based on the study's objective, which is often influenced by the social and industrial demand of foresters (Rekola et al., 2017, 2019).

2.4.1 Africa

A 2015 to 2016 survey conducted on 56 forest education training institutions in anglophone sub-Saharan Africa countries found out that the societal demand for forestry graduates is moving towards a generalist than specialist discipline. Emerging topics in the field of forestry are deficient in the curriculum. There is a shortage of teaching materials such as laboratory equipment and books, there is negligible government and donor support; and ICT facilities are not reliable. The report recommended that training institutions should collaborate with relevant stakeholders for joint development and review of curricula and there could be development of regional centers of excellence on topics of mutual interest (Katsvanga & Mudyiwa, 2019).

A commissioned study by the Joint IUFRO-IFSA Taskforce on Forest Education shows that most forest education graduates in three African countries (Cameroon, Ghana, and Nigeria) are not working in the forest sector mostly because of lack of jobs. Important social skills were also found to be deficient in graduates, and it is recommended that the curriculum be updated to meet present reality (Rekola et al., 2019).

The role of universities has been acknowledged to help achieve the goal of restoring Africa drylands (Pasiecznik & Reij, 2020). A recent Africa-wide study to assess forest education in Africa from primary to university level shows that forestry does not receive sufficient attention in primary and

secondary curriculum, thus causing non-interest in forestry higher education. The study also suggests that the forestry education offered at higher institutions is more theoretical and does not meet market needs. The use of digital education is one of the many suggestions for improvement (Kung'u et al., 2021).

A 2022 study conducted, and report published by IFSA[3] shows that the average number of forestry students is 274 and 60 per university in the IFSA Northern Africa and Southern Africa regions respectively. They both have a total of 6,738 students (58.18%) of the 11,581 global forestry student population (Hrbek et al., 2022). There is more to be known as the IFSA report was based on only 25 universities in Africa, whereas, Onatunji et al., (2021) listed 101 universities offering forestry degrees in 25 African countries.

International Organizations are also contributing to help promote forest education in Africa, for example the International Tropical Timber Organization (ITTO) supported a project on "Capacity building for the sustainable management of tropical rainforests and biodiversity conservation in the ITTO Congo Basin countries" between 2012 and 2019 (ITTO, 2020); and the Food and Agriculture Organization (FAO) of the United Nations with the support of other funders help carry out a regional assessment on forest education from primary to tertiary level in Africa (Kung'u et al., 2021). Last but not least, the International Union of Forest Research Organizations (IUFRO) with the support of IFSA helped publish a book that featured students, young professionals, inspiring leaders, and mentors who share their career success stories. The book is published in English and French, made available online free of charge[4] and over 500 free hard copies sent to universities across Africa (Onatunji et al., 2021).

2.4.1.1 Nigeria

On the vocational or technical level, forest education began quite early with the establishment of the Federal College of Forestry Ibadan in 1941. Favourable admission conditions make the choice of forestry degree easier for diploma students, and the majority (97%) of them are interested in pursuing further degree (Babalola & Onatunji, 2018).

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[3]NB: The limitation of IFSA data collection is that in some cases all forestry students are counted as local committee (LC) members but in other cases only part of the forestry students is at the same time IFSA members. So, the number may not reflect the true current situation globally.

[4] The book can be downloaded here: https://www.iufro.org/publications/other-publications/article/2021/07/17/building-a-successful-forestry-career-in-africa/

Forestry education at the university level began in Nigeria in 1963 with the support of FAO to establish a forest department at the University of Ibadan. Only a few proportions (less than 10%) of forest students in Nigeria choose the degree directly. Interestingly, more than 70% of students are willing to pursue a graduate degree after their bachelors (Onatunji & Babalola, 2019). It is remarkable to note that the number of universities offering forestry degrees in Nigeria is growing year by year, there are 20 in 2008 (Akande, 2008); 34 in 2018 (Chukwu et al., 2018) and 41 in 2021 (Onatunji et al., 2021).

Nigeria recently published a national strategy to combat wildlife and forest crime in the country of which the roles of forestry research were prominently featured as the Forest Research Institute of Nigeria is one of the key partners in achieving the objectives of the strategy (Nigeria Federal Department of Forestry, 2022).

Forestry graduates in Nigeria often need a long period of time to get a job in the forestry and forest-related sector and the proportion of those who actually find forestry jobs are low (Rekola et al., 2019). A recent study of a cohort of forestry graduates in one of the top forestry universities in Nigeria, the Federal University of Technology Akure, Ondo state, shows that most (84%) graduates were only able to find job in non-forestry sector after 5 years of graduation. Those who were able to find forestry worked mainly as scholars, researchers, and lecturers in universities in Nigeria and abroad. The study also emphasized that the situation reflect a general employment trend in the country rather than the forest sector alone (Adeyanju et al., 2022).

2.4.1.2 Uganda

Uganda has about 3.5 million ha of forests as of 2020 (FAO, 2020c). Makerere University is the only university offering a university-level forester degree in Uganda. In 2002, the university conducted a series of activities with various stakeholders to adapt the forestry curriculum to adapt to current social demands and social needs of professional foresters. The reforms objectives include changing from a discipline-based to an issue-based approach; balancing curriculum on technical, social, and ecological aspects; field-based learning; in-service education linked to formal and informal education; and networking and linkages to achieve the other objectives (Buyinza, 2004). Field-based learning is evident as the cover page picture of an Africa-wide book on *Building a Successful Forestry Career in Africa: Inspirational Stories and Opportunities* is ‘of forest students from the Makerere University, Uganda, measuring the diameter of a tree in Budongo Central Forest Reserve, Uganda, during their practical class (Onatunji et al., 2021).

In a 2019 update study, conclude that the current forestry education objectives, content, and delivery methods in Makerere University Uganda do not adequately respond to the changing needs of conservation, management and sustainable development nor adequately issues of food security and poverty alleviation. Forestry students recognize that forest education should be better informed about the needs of the entire forest sector, rather than the narrow view presented by the current system (Buyinza & Vedeld, 2009).

2.4.2 Europe

Europe has a fair amount of forest that covers 45.97% of the total land area (FAO, 2020d). In light of green jobs in the forest sector, theory and practice courses or modules related to Forest ecotherapy are not featured in the curriculum of most forestry schools and universities, as this will be required skills of new cohort of professional foresters (FAO & UNECE, 2018).

A recent study on the knowledge of European forest students from 29 universities across 9 countries shows that 70% of them have heard about bioeconomy through university courses and they also perceive the forest-based sector currently contribute (and is the most important contributor) to the bioeconomy in Europe and at national level (Masiero et al., 2020). Some of the international education activities in Europe are joint Master's degrees funded by the European Union. A typical example is the Mediterranean Forestry and Natural Resources Management Master Program (MEDfOR) which brought Universities to Mediterranean countries of Portugal, Spain, Italy, and Turkey since 2012 and has graduated 98 students by 2019 (Tavares & Borges, 2021).

Findings from a 2020 European wide survey of forest students (including recent graduates), teachers, and professionals indicate that they have similar perceptions of forest education. Topics related to gender, ethnicity, traditional and indigenous knowledge are said to be limited in curricula, while those relating to silviculture and forest planning are excessively covered. There is also strong encouragement for outdoor learning opportunities, such as visits to the forest (Rekola et al., 2021).

2.4.2.1 Italy

Italy has a total of 11,431,000 ha of forest, employs 8690 in the forestry sector at the full-time level, and graduated 4,869 forest students in 2015 according to the FAO Global Forest Resources Assessment 2020 (FAO, 2020b). There are 14 Italian universities offering forest sciences degrees (Cardellini et al., 2012). In recent decades, the use of forests for human health and wellness activities has become

popular, which was proposed with a new term called ‘forest care initiatives (FCI)” was proposed. There are about 232 FCI initiatives in Italy, largely promoted by private and civil society organizations and their relevance is increasing with the COVID-19 pandemic, which is making more people go into nature (Doimo et al., 2021).

In an EU-wide survey of forestry students on bioeconomy, 52% of Italian respondents have heard about bioeconomy before, of which 26% of them through university courses (Masiero et al., 2020). The ECOSTAR project developed by the University of Padova and ETIFOR srl, which was one of the finalists recognized in a global best practice in forest education, was one of the finalists. The project, which has to promote sustainable entrepreneurship in the forest sector around the world and helped to highlight on how Italian universities are contributing to sustainable forest management beyond the shores of Italy (IUFRO, 2019).

The role of universities in helping find innovative preventive and corrective solutions to challenges that ecological systems in the future have been reported to be significant in Italy. For example, the University of Padova responds to the aftermath of the Vaia storm, which is an unprecedentedly extreme event that hit north-east Italy between October and November 2018. The university contributed to research, educational, and communication activities and side initiatives with other partner organizations (Masiero et al., 2021).

2.4.2.2 Spain

Forestry education at the tertiary level in Spain started on August 18, 1847, with the Special School of Forestry Engineering, and the first curriculum of the degree is established, which is a four-year degree. The degree has evolved over time from *“practical training based on naturalism*” (1847-1899); “*towards a more productivist approach”* (1900-1944); *“a technology specialist training”* (1945-1999); to *“forest engineering in the EHEA”* (since 2000) to be consistent with the bologna process (Muncharaz et al., 2015). There is an ongoing increase in enrolments for Lifelong Learning (LLL) programmes and they are increasingly linked to companies and professional associations, rather than to universities, raising doubts on the part universities will play in the future of LLL in Forestry (Vega-garcia & Alcázar, 2016).

In a recent global competition on best practices in forest education, the University of Valladolid in Spain was recognized for their innovative use of virtual forests in teaching in the classroom. The videos are co-created with students and bring the forest to the classroom. The University of Lleida, Spain,

was also recognized in the same competition for being part of a consortium of top universities in Europe offering a Master's degree in European forestry (Owuor & Rodríguez-piñeros, 2021; Rodríguez-Piñeros et al., 2020).

Chapter 3: Methodology

3.0 Introduction

This chapter documents the process and methodology followed in carrying out this research. From the conceptualization of idea to the final production of the thesis.

3.1 Conceptualization and supervision

The author was inspired on this topic by his experiences as an international forestry student during the COVID-19 pandemic. He was offered admission and scholarship during the pandemic had most of his lectures online during his first year as a Master Student at the University of Llieda, Spain. The author will later refer to himself as 'pandemic student'[5]. The author approached Professor Laura Secco[6] based on her research interest in forest policy and governance and her interest in the topic. She also offered guidance on how the research can be improved early on. The co-supervisor, Assistant Prof. Folaranmi D. Babalola, was approached by the author based on his experience and passion in teaching forestry science in Nigeria and South Africa to provide an African perspective on the multicontinental study. Dr. Babalola was also one of the coauthors of a recently published book on building a successful forestry career in Africa.[7] The author drafted the research proposal and shared it with the supervisors who provided feedback and improved it. The supervisors continue to provide guidance and ideas until the completion of the study.

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[5] Based on Onatunji, Alex B. (2022): *Reflections of an international student in Europe on Learning Forest Science in the COVID-19 Pandemic Era.* A presentation during the SILVA Network Annual Conference - Higher Forestry education in times of multiple crises: crises as framework conditions, challenges, and triggers for improvements at the University College Dublin, Ireland, June 28 – 30 2022. page 15. Retrieved from http://dx.doi.org/10.13140/RG.2.2.26268.16005 [accessed June 30, 2022].

[6] *"Dear Alex, your draft is excellently written and structured, and on a super-important topic! Well done, indeed! I have confidence you will become a Professor in Forest Sciences, in future, as you are already taking care of students!! The fact that you got so many comments from your e-fellows is an indicator of the relevance of the topic..."* - I hereby acknowledge my cherished comment provided by Prof. Laura Secco on the research concept note during on an online course AVP7078738 – "Research and Project Development Methodology: Applications".

[7] Onatunji, A. B., Owuor, J. A., Rodriguez-Piñeros, S., **Babalola, F. D.,** Akello, S. and Adeyemi, O., (2021): Building a Successful Forestry Career in Africa: Inspirational Stories and Opportunities. International Union of Forest Research Organizations, Vienna, Austria. 120 p. ISBN Number: 978-3-903345-09-6 Available online at https://www.iufro.org/fileadmin/material/publications/other-publications/building-a-successful-forestry-career-in-africa.pdf [accessed August 19, 2021].

3.2 Study area

Today's students will become future forest managers, officials, and consultants to manage forest resources and beyond (Havenga, 2019; Jegatheswaran et al., 2018). To better understand how the COVID-19 pandemic is perceived and how virtual teaching/learning is perceived, this study was conducted with forestry students and lecturers on a well-developed continent of Europe and the developing continent of Africa. Nigeria and Uganda are the two countries selected in Africa, while Italy and Spain were chosen in Europe. The selection was influenced by countries and institutions where the author has contacts and will be able to stimulate responses.

The four selected countries are important forest countries, each with its peculiar forest challenges and the need to have well-prepared professionals in the future. Table 1 explains some key information about forestry in each selected country. A longer description of forest education in countries is available in Section 4 of Chapter 2 of this thesis.

Table 1: A summary of key and important information about forestry in selected countries according to the FAO Global Forest Resource Assessment 2020

S/N	Continent	Country	Forest Area (% of the total country area) in 2020	Significant forest disturbance/challenges	Number of forest graduates in 2015*
1.	**Africa**	**Nigeria**	21,626,950ha (23.75)	Increasing deforestation and forest degradation. The estimated loss of forest cover between 1990 and 2020 is 4.8999,140 ha.	Official data is not available.
2.		**Uganda**	2,337,900ha (11.66)	Increasing deforestation and forest degradation. The estimated forest cover loss between 1990 and 2020 is 1,237,570ha.	Official data is not available.
		Kenya	3611.09ha (6.35)	Increasing deforestation and demand for wood fuel and charcoal. The estimated loss of forest cover between 1990 and 2020 is 24,7450ha.	Official data is not available.
3.	**Europe**	**Italy**	9,566,130ha (32.52)	Increasing forest fires, 113,566ha of forest burned in 2017.	4,869
4.		**Spain**	18,572,170ha (37.17)	Increasing forest fires, with 66,840ha of forest burned in 2017.	939

* This is the total number of Bachelor's to a Ph.D. degree graduates. In some cases, the data is averaged for about five years.

Source: FAO, (2020d).

3.3 Sampling method for selected universities and survey target audience

Table 2: List of universities selected for the study

S/N	Continent	Country	University	Year of establishment of the university establishment	Included in the final analysis
1.	**Africa**	**Nigeria**	University of Ibadan, Ibadan	1948	Yes
2.			University of Ilorin, Ilorin	1975	Yes
3.			University of Maiduguri, Maiduguri	1975	Yes
4.			Federal University of Technology Akure	1981	Yes
5.		**Uganda**	Makerere University Kampala	1922	Yes
6.			Ndejje University, Luwero	1992	No[8]
7.		**Kenya**[9]	Kenyatta University	1985	No
8.			University of Eldoret	1946	No
9.			Maasai Mara University	2008	No
10.	**Europe**	**Italy**	University of Padua	1222	Yes
11.			University of Florence	1321	Yes
12.			University of Tuscia	1979	Yes
13.		**Spain**	Universidad de Valladolid (Palencia)	1241	Yes
14.			University of Lleida	1297	Yes

Source: Author elaboration

The researcher first performed an online search to generate the name and year of establishment of universities offering forest services in the selected countries. Based on the information provided in the footnote, Kenya was removed from the final analysis and is no longer mentioned in the document. The number of universities that offer forestry degrees is 11 in Italy, 41 in Nigeria, 12 in Spain, and two in Uganda, making a total of 66. A complete list is provided in the Appendix. The convenience sampling method (Masiero et al., 2020) is used to select universities that are important forest education providers and where the author has contacts in the selected countries.

The study and the survey focused on two distinct audiences, the first being Bachelor, Master and PhD degree students in forest sciences, and the second audience is their lecturers or teachers. With the use of digital survey as a low-cost form of administration and elimination of the data entry process through a digital questionnaire, the study used non-probability sampling (convenience sampling), as it will be

[8] There was no response to all the emails sent to the university, thus no data was collected from it. This makes Makerere University Kampala the only sampled university for the study in Uganda.

[9] Kenya as a country was dropped in the final analysis as only one lecturer responded from Kenyatta University and two lecturers from the University of Eldoret. There was no single response from students, possibly the lecturers did not share the survey with them despite several follow up emails.

more resource intensive to conduct statistical representative information per university/country. Thus, the survey was answered by as many respondents as possible (Masiero et al., 2020).

3.4 Questionnaire drafting and pilot testing

This study used a survey method, as used in other similar studies, to collect the opinion of students and teachers on the impact of the COVID-19 pandemic on the teaching and learning of forest degrees in selected universities. The author drafted a structured questionnaire with the support of similar studies and consulted relevant studies (Dodson & Blinn, 2021, 2022). The drafted questionnaire was shared with the two supervisors who provided a detailed review of content, context, and grammar. This review process helped with clarifying the questions and provided insight into perspectives that the author did not consider.

The draft questionnaire was then converted into an online survey, using a free and open-source data collection platform known as Kobotoolbox (www.kobotoolbox.org). Adopting a digital questionnaire to eliminate the use of paper in collecting data, reduce the time in collating data, and reduce errors. Another advantage is that the platform can collect on-line and offline data and be analyzed as soon as the data is collected (Babalola & Onatunji, 2018).

A pilot test of the questionnaire was carried out by sending the link to the online questionnaire to ten forestry lecturers and 15 forestry students by email to provide feedback about the questionnaire. The population used for the pretest was representative of the countries and universities where the questionnaire will be administered. The pilot test sample population was required to provide answers to the following statements: How long it took to fill out the questionnaire (minutes); If the questions are clear and understandable enough and point attention to anything unclear; If the platform is easy to navigate as a respondent; and any other point for improvement.

A response rate of 68% was achieved, as a total of 17 of 25 responses were received. A short breakdown shows the responses of four **lecturers (4), one** from Italy, Kenya, Nigeria, and Spain, with a gender balance of 2:2; and **students (13) -** Italy (2), Nigeria (3), Spain (1), and Uganda (7) and with 3 females to 10 males. Students took between 15 and 33 minutes and lecturers between 14 and 29 minutes to complete the survey. I think the questionnaire passed the time test. Most of the comments revolved around technical aspects of the right questions to the right person. About 5 people complained that the questions were too long and suggested that maybe some of them could be merged. Some students, especially Nigerians, suggest adding 'post-pandemic' options; in their view, the heat of the

pandemic is over, and things are relatively stable now. In the words of one of the professors – *"I would focus more on questions concerning the personal assessment on the pandemic online learning/ teaching. It is not important whether you used Webex or Blackboard. What is important is if it was synchronic, asynchronous, paper-doc based, etc.*

All responses and feedback were shared with the supervisors. The questionnaire was adequately amended through integrating the suggestion before the final questionnaire was developed (Figure 4). For data collection, a link to the questionnaire was sent to the target respondents.

3.5 Data collection and survey distribution

The corrected link to the online questionnaire was distributed to the target audience in each identified university by email to students, student coordinators, lecturers, and department head by email and WhatsApp between June 21 and August 10, 2022 (7 weeks or 50 days). A flyer was designed to help share the survey among the participants.

The respondents agreed to the privacy notice which reads: *"Data collected through this survey will be treated confidentially and anonymously, elaborated, and used in aggregated forms, exclusively for my thesis research purposes, complying with the General Data Protection Regulation (GDPR), Regulation (EU) 2016/679, as well as with the new "Code for the Integrity of the Research" approved by the University of Padova on the 14.09.2021. You permit me to process the data you provide for this project research by filling in the questionnaire"* before they could proceed to answer the questionnaire. The author's phone and email contacts were also provided in case the respondents needed to get in touch or have any comments.

The author shared the survey by email directly to 36 lecturers and 76 students. The supervisor, Prof. Laura Secco, sent emails to 55 lecturers from the University of Padova, Italy, and co-supervisor, Dr. Folaranmi Babalola, also shared the survey via his personal networks with students and lecturers in the selected universities. Follow-up emails and WhatsApp messages were sent to encourage participation in the online survey on July 10, 2022. Due to the small number of responses from Europe, a second follow-up email was sent to all European respondents by 26 July 2022, to encourage them to share the survey with their colleagues (lecturers and students) who are eligible to answer the questionnaire. At the end of the survey, 238 complete responses were received from both students and lecturers.

Figure 3: Customized sample flyer for data collection
Source: Author

Data collection faced some challenges, of which some probable reasons are given. First, there are a high number of responses from Nigeria, which can be attributed to the high number of forest students in the country. According to the regional representative of the IFSA of Northern Africa, a recent data collection in May 2022 by the IFSA shows that the four Nigerian universities sampled have a total of 1,317 forestry students (who are probably just undergraduates)[10]. Second, there could be a bias in reaching out to students and lecturers, as the author has an extensive network and contacts of Nigerian forestry students and lecturers, as he had previously served as the IFSA Northern regional representative. Third, the low number of responses from European students could be related to the examination period in June - July, and the author had to motivate European students more. Furthermore, the author does not have direct access to many of the forest students in the European universities, so he had to rely mostly on a third party (professors) to help share the information with the students. Fourth, due to time and economic constraints, this survey was administered only in English and not translated into local languages; and it was not supplemented with a hardcopy questionnaire available in some other European studies such as Masiero et al. (2020). Fifth, the general

[10]Personal communication with Samuel Japheth, IFSA Northern Africa Regional Representative (2021-2022), July 04, 2022.

low number of responses from Europe could be attributed to the fact that there are many more forestry students in Africa than Europe[11]. Sixth and last, African students are more interested in the thesis topic because they have been more harshly affected by the negative consequences of the virtual teaching than European ones, and thus are willing to contribute to understand how to prevent future problems.

It is interesting to note that about 70% (165 people) of the respondents were interested in receiving the abstract of the thesis by indicating in the questionnaire and providing their email address.

Figure 4: A screenshot of the online questionnaire
Source: Author

[11]Author assumption based on Onatunji & Babalola, (2019) which estimated that there are about 6,000 – 10,000 undergraduate forestry students in Nigerian Universities in 2019.

3.6 Data analysis

The digital data collection platform used for the study was designed in such a way that it does not allow the submission of incomplete questionnaire responses, so that all the 238 collected were successfully completed and analyzed. Microsoft 365 Excel was used to collect descriptive information on universities that offer forestry in the selected countries descriptively and was used to analyze the data collected from the survey.

3.7 Assumptions and limitations of the results

Despite the rigorous scientific procedure that was followed in carrying out this study, there were still some limitations. First, the selected countries did not represent the entire situation on the two chosen continents, and the chosen universities may not describe the whole situation in each country. Second, due to the peculiarity of an online survey and data collection, the level of responsiveness and the number of responses may not entirely represent the situations on the ground. Therefore, representation cannot be guaranteed. Third, comparisons across countries and continents will not be perfect due to inherent differences in academic administrations, systems/structure, and policies in each country. Fourth and last, due to funding and travel limits, the researcher had to solely rely on online data collection, without the opportunity to verify information on the ground.

Chapter 4: Results and Discussion

4.0 Introduction

This chapter presents the results of this study. It is sub-divided into six sections. Section one presents demographic information; Section two on perspectives on virtual teaching and learning before and during the COVID-19 pandemic; Section three on challenges faced and experienced forestry lecturers and students during the COVID-19 pandemic; section four on prospects of online teaching and learning of forest sciences post COVID-19 pandemic; and section five on looking beyond teaching and learning forest science in the COVID-19 pandemic era; and section six on the overall synthesis. Each of the sections presents tables and/or graphs and a short description of the key results.

4.1 Demographic information

The total number of responses received and analyzed for the study was 238, of which 23 are lecturers and 215 are students representing 9.66% and 90.34%, respectively.

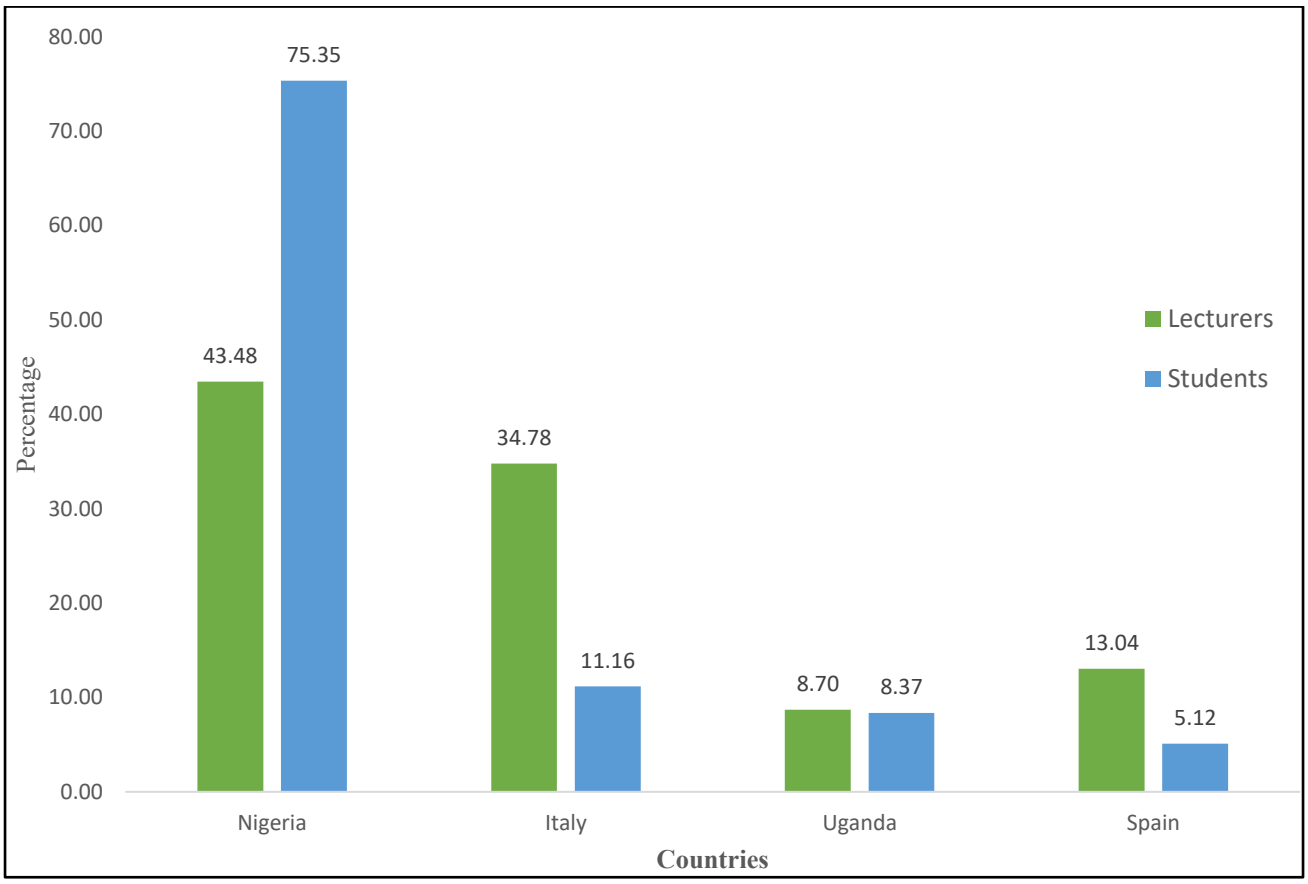

Figure 5: Respondents country of learning/teaching
Source: Data Analysis

Among the four countries in the survey, Nigeria has the highest number of respondents who study and teach forest science in selected universities. The probable reason why more students and lecturers from Nigeria responded according to Figure 5 is due to the high population of forestry student and lecturers in the country. At least 6,000 – 10,000 undergraduate forestry students studying in Nigerian universities in 2019 (Onatunji & Babalola, 2019).

Table 3 shows that 83.72% of the student respondents were from African universities. University of Maiduguri leads in the number of responses with 56 students, representing 26.05% of all the respondents. The high number of African Africa could be attributed to the high number of students enrolled in forestry degrees at universities in Africa[12]. For example, a recent membership survey conducted by IFSA reported an average of 270 forestry students in 25 African universities versus an average of 49 forestry students in 49 European universities (Hrbek et al., 2022)[13]. Another probable reason is that African students are more interested in the topic because they have been more severely affected by the negative consequences of the virtual teaching than European students and thus are willing to contribute to understand how to prevent future problems.

Most (56.74 %) of the respondents were between 18 and 24 years. This is good news as there are reports of an ageing workforce in the forest sector, especially in Europe (Da Silva & Schweinle, 2022) and how the forestry sector should do more to attract young people (Onatunji et al., 2021; Owuor et al., 2021). Also, Oginni et al., (2021) reported that younger students prefer face-to-face class compared to older students who prefer online class.

There were more male (59.7%) than female (40.0%) students who responded to the survey. Based on available country data, the proportion of women to men who graduate from forestry degree around the world is on the increase, around one-third in 2015 (FAO, 2020d). In the recently published IFSA membership report, the proportion of male and female is more or less the same (Hrbek et al., 2022). Different sociocultural backgrounds contribute to the number of women studying forestry or in the forestry sector, such as little attraction and how forestry is often as a sector for women (Bal et al.,

[12] Author assumption based on Onatunji & Babalola, (2019) which estimated that there are about 6,000 – 10,000 undergraduate forestry students in Nigerian Universities in 2019.

[13] NB: The limitation of IFSA data collection is that in some cases all forestry students are counted as local committee (LC) members but in other cases only part of the forestry students is at the same time IFSA members. So, the number may not reflect the true current situation globally.

2020; Da Silva & Schweinle, 2022; Polinko & Coupland, 2021; Searle & Bryant, 2009; Sharik et al., 2015). The forestry sector needs to do more to encourage women to pursue forestry education and careers such as gender policy and mentorship (Grubbström & Powell, 2020; Roos et al., 2021).

Most African students (92.22 %) were pursuing their bachelor's degree, while 85.71% of the European students were master's seeking their master's degree. African students did not undergo any form of exchange while more than half (55%) of their European counterparts were taking part in an Erasmus +, Erasmus Mundus or a Joint Study programme. The Bologna declaration makes academic course credits comparable within the European Higher Education Area, thus serving as bedrock for academic collaborations between countries and universities. These kinds of cooperation are especially important in developing a labour force that is well aware of forestry practices beyond their country of study and help foster European mobility of labour (de Jong et al., 2021; Kanowski, 2020; Lewark, 2021; Owuor & Rodríguez-piñeros, 2021; Tavares & Borges, 2021).

There is a low level of diversity of international students in the African universities sampled, compared to the European universities where students came from 18 countries. The low level of diversity of international students and forestry teachers in Africa could be attributed to the low level of scholarships available to students (Gabay & Rekola, 2019). The proportion of Nigeria students in European universities is 22.86% and a previous study in Nigeria shows that 83.97% of the student's desire to seek postgraduate study outside their home country (Onatunji, 2021). The diversity of students and students in the forestry program in Europe has been reported in other studies, since scholarships are more available (de Jong et al., 2021; Tavares & Borges, 2021).

Table 3: Demographic information for students

Demographics	**Africa**		**Europe**		**Grand total**	
	n	**%**	**n**	**%**	**n**	**%**
Continent						
Africa	180	83.72				
Europe			35	16.28		
Total	**180**	**83.72**	**35**	**16.28**	**215**	**100.00**
Name of respondent university						
Federal University of Technology Akure	38	21.11			38	17.67
Makerere University	18	10.00			18	8.37
University of Ibadan	36	20.00			36	16.74
University of Ilorin	32	17.78			32	14.88
University of Lleida			5	14.29	5	2.33
University of Maiduguri	56	31.11			56	26.05
University of Padova			16	45.71	16	7.44
University of Tuscia			8	22.86	8	3.72
University of Valladolid			6	17.14	6	2.79

Total	**180**	**100.00**	**35**	**100.00**	**215**	**100.00**
Age						
18 – 24 years	116	64.44	6	17.14	122	56.74
25 – 34 years	60	33.33	25	71.43	85	39.53
35 – 44 years	4	2.22	4	11.43	8	3.72
45 years and above	0	0.00	0	0.00	0	0.00
Total	**180**	**100.00**	**35**	**100.00**	**215**	**100.00**
Gender						
Female	72	40.00	14	40.00	86	40.00
I prefer not to say	2	1.11		0.00	2	0.93
Male	106	58.89	21	60.00	127	59.07
Total	**180**	**100.00**	**35**	**100.00**	**215**	**100.00**
Current level of studies						
Bachelors or equivalent	166	92.22	4	11.43	170	79.07
Masters or equivalent	12	6.67	30	85.71	42	19.53
PhD or equivalent	2	1.11	1	2.86	3	1.40
Total	**180**	**100.00**	**35**	**100.00**	**215**	**100.00**
Are you an Erasmus student, or are you participating in another exchange program (Joint Study, CEEPUS, etc.)?						
No	180	100.00	14	40.00	157	73.02
Other (please specify)	0	0.00	1	2.86	4	1.86
Yes, Erasmus	0	0.00	2	5.71	28	13.02
Yes, Erasmus Mundus	0	0.00	16	45.71	19	8.84
Yes, Joint Study	0	0.00	2	5.71	7	3.26
Total	**180**	**100.00**	**35**	**100.00**	**215**	**100.00**
Nationality (Country of origin)						
Argentine			1	2.86	1	0.47
Bangladesh			1	2.86	1	0.47
Brazil			2	5.71	2	0.93
Cameroon			1	2.86	1	0.47
China			1	2.86	1	0.47
Colombia			1	2.86	1	0.47
Czech			1	2.86	1	0.47
Ethiopia			2	5.71	2	0.93
Finland			1	2.86	1	0.47
Indian			1	2.86	1	0.47
Indonesian			1	2.86	1	0.47
Iran			2	5.71	2	0.93
Italy			5	14.29	5	2.33
Jordan			1	2.86	1	0.47
Nigeria	161	89.44	8	22.86	169	78.60
Pakistan			2	5.71	2	0.93
Spain			3	8.57	3	1.40
Turkiye (Formerly Turkey)			1	2.86	1	0.47
Uganda	18	10.00			18	8.37
No response	1	0.56			1	0.47
Total	**180**	**100.00**	**35**	**100.00**	**215**	**100.00**

Source: Data Analysis

The result in Table 4 presents the demographic information of the lecturers. None of the lecturers is below 35 years of age. Age can contribute to the use of technology as older lecturers will need more time and training to be able to adapt to virtual teaching effectively.

There are no significant gender differences between lecturers and students, and this study is limited to knowing the level of gender diversity at the universities sampled. The gender issue in forestry studies varies widely, such as gender-based violence (K. Johansson et al., 2018; M. Johansson et al., 2018; Long, 2021); leadership and professionalism (Baublyte et al., 2019; K. Johansson et al., 2020; Larasatie et al., 2020); Inequality in forest science, research, communication, and forestry sector (Colfer, 2021; Kern et al., 2015; Koch & Matviichuk, 2021; Macinnis-Ng & Zhao, 2022; Ringblom & Johansson, 2020; Sanz-Hernández et al., 2022).

Universities offering forestry degrees should diversify their staff as all the lecturers who responded to the survey are nationals of the respective countries where the university is located. We need to look at the internationalization of higher education beyond only international student recruitment. Most of the lecturers in Africa (66.67%) had *'Lecturer' 'Lecturer'* as their academic title while *'Research Associate / Fellow'* took the lead in Europe with 36.36% of the respondents. The years of teaching experience ranges from 2 to 16 years for African lecturers and from 4 to 35 years for European lecturers. It is difficult to compare these data; however, a similar study of Professors teaching Forest Operations courses in the United States of America found an average of 13 years teaching experience as in this study (Dodson & Blinn, 2022).

Table 4: Lecturers demographic information

	Africa		Europe		Total	
Demographics	**n**	**%**	**n**	**%**	**n**	**%**
Age						
Less than 35 years	0	0.00	0	0.00	0	0.00
35 – 44 years	5	41.67	7	63.64	12	52.17
45 – 54 years	7	58.33	1	9.09	8	34.78
55 – 64 years	0	0.00	2	18.18	2	8.70
65 years and above	0	0.00	1	9.09	1	4.35
Total	**12**	**100.00**	**11**	**100.00**	**23**	**100.00**
Gender						
Female	6	50.00	4	36.36	10	43.48
Male	6	50.00	7	63.64	13	56.52
Total	**12**	**100.00**	**11**	**100.00**	**23**	**100.00**
University name						0.00
Federal University of Technology Akure	2	16.67			2	8.70
Makerere University	2	16.67			2	8.70
University of Florence			2	18.18	2	8.70
University of Ibadan	2	16.67			2	8.70
University of Ilorin	4	33.33			4	17.39
University of Lleida			2	18.18	2	8.70
University of Maiduguri	2	16.67			2	8.70
University of Padova			6	54.55	6	26.09
University of Valladolid			1	9.09	1	4.35

Total	**12**	**100.00**	**11**	**100.00**	**23**	**100.00**
Nationality (Country of origin)						
Italy			7	63.64	7	30.43
Italy and Britian			1	9.09	1	4.35
Nigeria	10	83.33			10	43.48
Spain			3	27.27	3	13.04
Uganda	2	16.67			2	8.70
Total	**12**	**100.00**	**11**	**100.00**	**23**	**100.00**
Current academic position/title		0.00		0.00		0.00
PhD		0.00	1	9.09	1	4.35
Lecturer	8	66.67		0.00	8	34.78
Senior Lecturer	2	16.67		0.00	2	8.70
Research Associate/Fellow		0.00	4	36.36	4	17.39
Associate/Assistant Professor	1	8.33	3	27.27	4	17.39
Associate Professor/HOD Forestry and Wildlife Department	1	8.33		0.00	1	4.35
Professor	0	0.00	3	27.27	3	13.04
Total	**12**	**100.00**	**11**	**100.00**	**23**	**100.00**
Years of academic teaching experience						
Mode		7 years		17.5 years		
Mean		12.8 years		13.2 years		
Range		2 to 16 years		4 to 35 years		

Source: Data Analysis

4.2 Perspectives on virtual teaching and learning before and during the COVID-19 pandemic

This section discusses the result of the perspectives on virtual teaching and learning before and during the COVID-19 pandemic of lecturers and students. The results and discussion were provided in three sub-sections.

4.2.1 Use of virtual teaching, university policies, video platforms, and pedagogy training

The respondents were asked the question – "were online/virtual teaching adopted in all the courses of your forest science programme (all levels)?", the result is shown in Figure 6. The graph shows that the use of virtual teaching for forest science courses before the COVID-19 pandemic is extremely low, and there was a spike in the use caused by the pandemic. It is worth mentioning that almost half (46.1%) of African students said that virtual teaching was not implemented in their universities despite the COVID-19 pandemic. The proportion of African students who took virtual classes both before and during the pandemic is lower compared those of European students. For lecturers, the majority of respondents from both Africans and Europeans have used virtual teaching method during the pandemic only. Furthermore, 8.3% of African lecturers compared to 18.2% of European lecturers stated that they used online teaching mode both before and during the pandemic. The use of virtual teaching/learning could be encouraged in Africa through improved funding for purchase or improvement of computer technologies, both software and hardware (Kachaka & Nkwinkwa, 2020; Kung'u et al., 2021); and

through collaboration with universities and partners within and outside the continent (Evans et al., 2010; Längin et al., 2004).

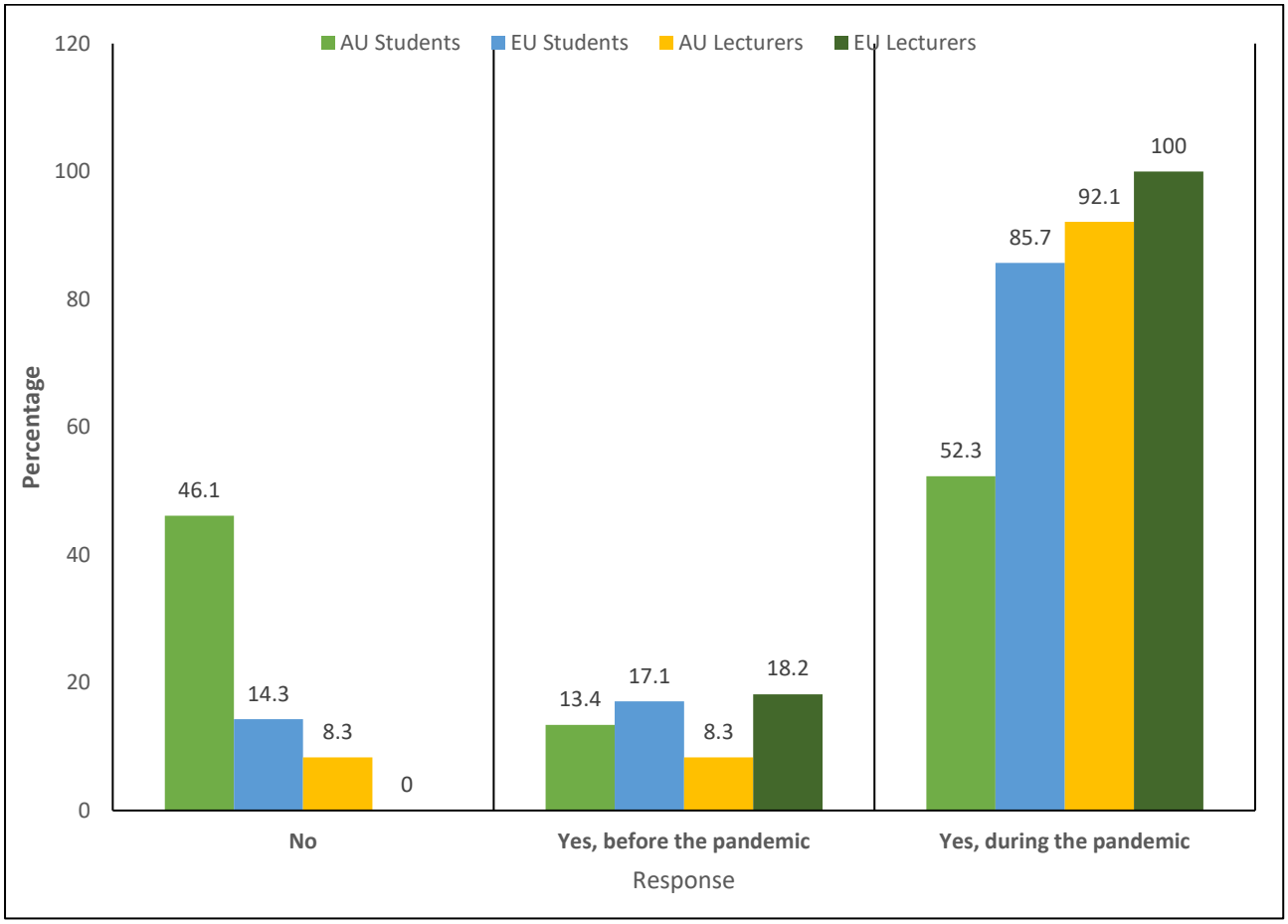

Figure 6: Were online/virtual teaching adopted in all the courses of your forest science programme (all levels)?
NB: Students (n = 215) and Lecturers (n = 23).

Source: Data Analysis

The lecturers were asked a follow-up question on the institutional policies adopted in the teaching of forest science online by their respective universities before and during the pandemic, the result is shown in Figure 7. All lecturers, both Africans and Europeans, stated that their university policies have allowed them to take a course, module, or entire programme online to varying extent to which they can be used. A full degree can be taught entirely online according to 18.2%, 18.2%, and 36.4% of African and European lecturers, respectively. It is not known yet whether the pandemic has forced universities to develop a full curriculum of forestry degree programmes, though (Dodson & Blinn, 2021) reported that students and instructors of forest operations courses in the United States have now taken a field-based course now virtually, using a mixture of methods. However, it has been highlighted that the objectives of forestry education cannot be fully realized without field experiences and personal

interactions (Dodson & Blinn, 2022; Lewoń & Pirożnikow, 2020). African universities should offer more flexibility on how forest education can be taught online.

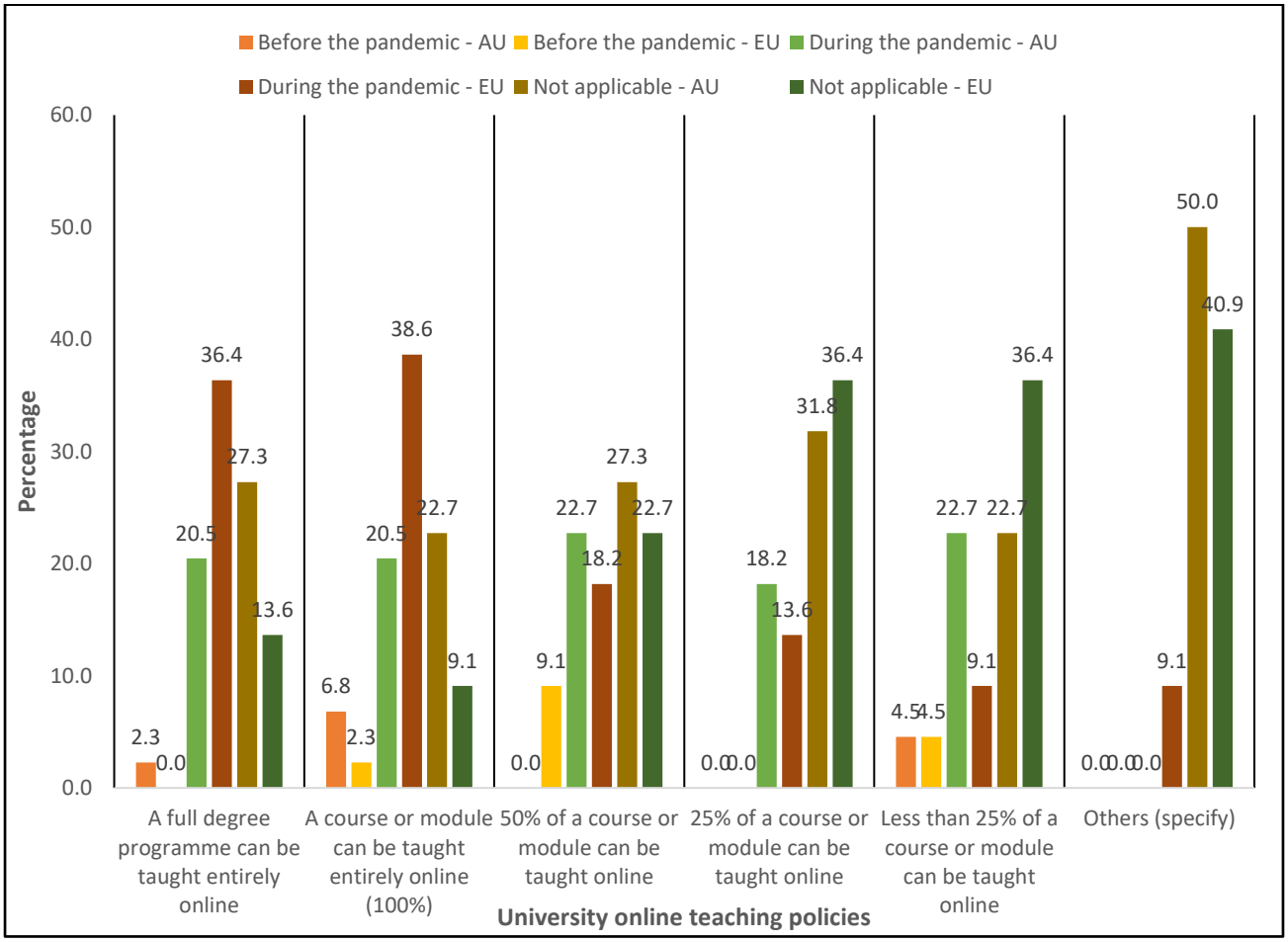

Figure 7: What policies on teaching forest science online have your university adopted before and during the pandemic? (n = 22)
Source: Data Analysis

The use of online videoconferencing platforms has been popularized for delivering education during the COVID-19 pandemic. The result of Figure 8 shows that Zoom (https://zoom.us/) is the number one online video conference platform used by the respondents, both students and lecturers (AU = 96.3% and EU = 70.7%). Other popular platforms used are Google meet (AU = 75.9% and EU = 43.9%), Blackboard Collaborate (AU = 50.0% and EU = 51.2%) and YouTube, pre-recorded lectures (AU = 50.0% and EU = 24.4%). Video conferencing has been used in teaching forest science during the pandemic (Dodson & Blinn, 2021, 2022; Lewoń & Pirożnikow, 2020; Ratnasingam et al., 2020) and even in forestry workforce online training (Macdonald et al., 2007). The use of online video conferencing tools comes close to face-face classes, and can help to improve interactions among lecturers and students (Hallal et al., 2020; Lewark & Karmann, 2015; Moosa, 2021). The preference for recorded and live video has been found to be similar among pharmacy students (Isah et al., 2021)

and could also cause anxiety and stress among students (Srivastava et al., 2021; X. Wang et al., 2020). In the future development of international virtual courses for forest science training courses, the Zoom platform should be recommended due to its current popularity and usage both in Africa and Europe.

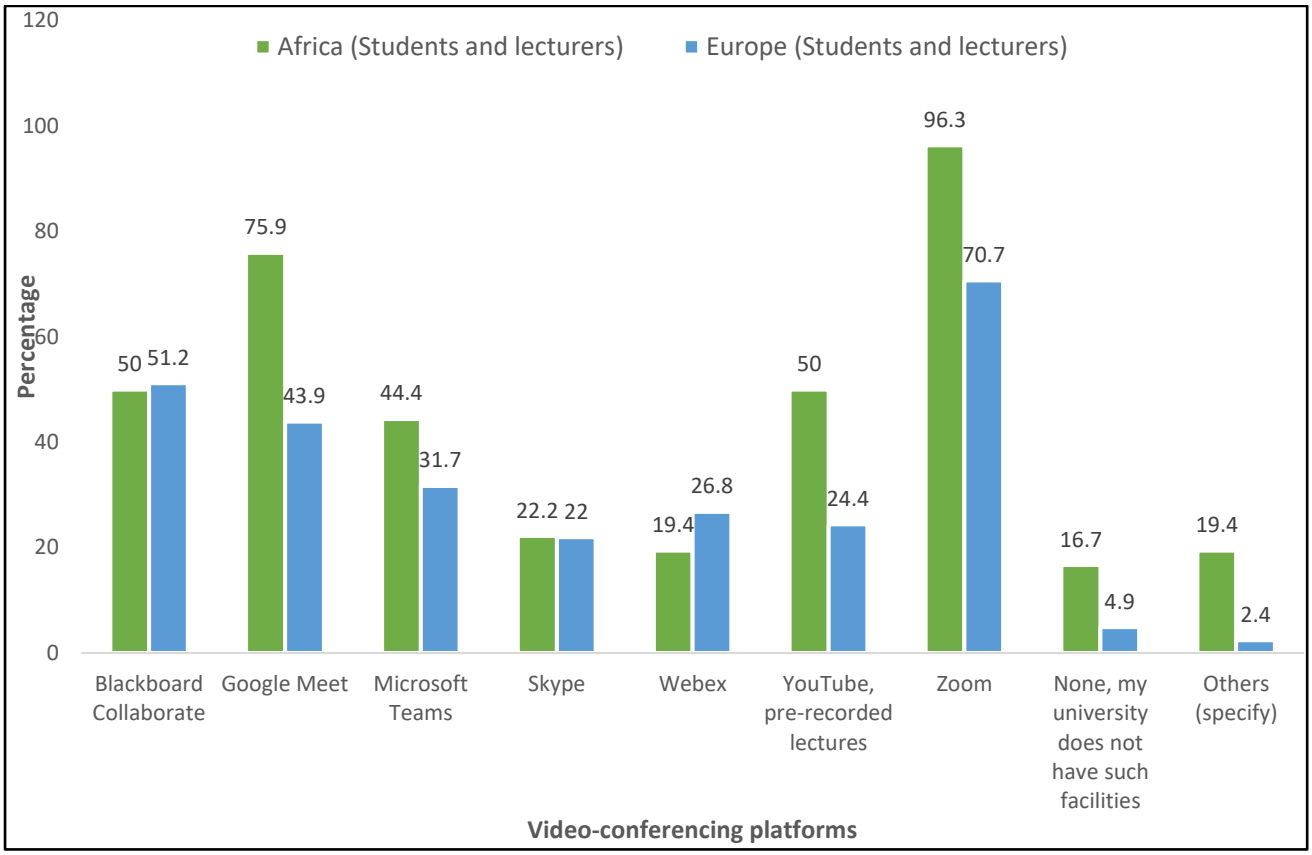

Figure 8: What platforms did your university use for online video lectures before or during the pandemic or both for forest sciences programmes? (n = 149)
Source: Data Analysis[14]

The lecturers were asked if their universities provided pedagogy training on delivering lectures online and if they attended them. The results in Figure 9 show that a large proportion of African and European lecturers received no technology pedagogy training on giving lectures online by their respective universities. There is an increase in the provision and attendance of this training due to the pandemic, from 20.8% to 45.8% for African lecturers and from 18.2% to 31.8% for European lecturers. The proportions of those who had access to these training courses when available but did not attend them also increased despite the COVID-19 pandemic. This may have been influenced in part by the limited time available for the lecturers to transition teaching online and other job commitments. Several studies

[14] This graph is based on the summation on the percentage of response for the use of listed platforms for – before the pandemic, during the pandemic, and both. The full result is available in the appendix section.

have confirmed that this kind of pedagogy training can help lecturers to adapt to the emergency remote teaching, make it effective to use digital technology, expose students to new technology, provides flexibility, and overall improve the quality of education provided. It is recommended that universities should provide forestry lecturers with training on digital teaching technologies and provide incentives for attending them (Alatni et al., 2021; Ali, 2020; Bryson & Andres, 2020; Ferede et al., 2022; Keengwe & Kidd, 2010; Leiba & Gafni, 2021; Rashid & Yadav, 2020; Rekola, 2019; Sauphayana, 2021; Sultanova et al., 2021).

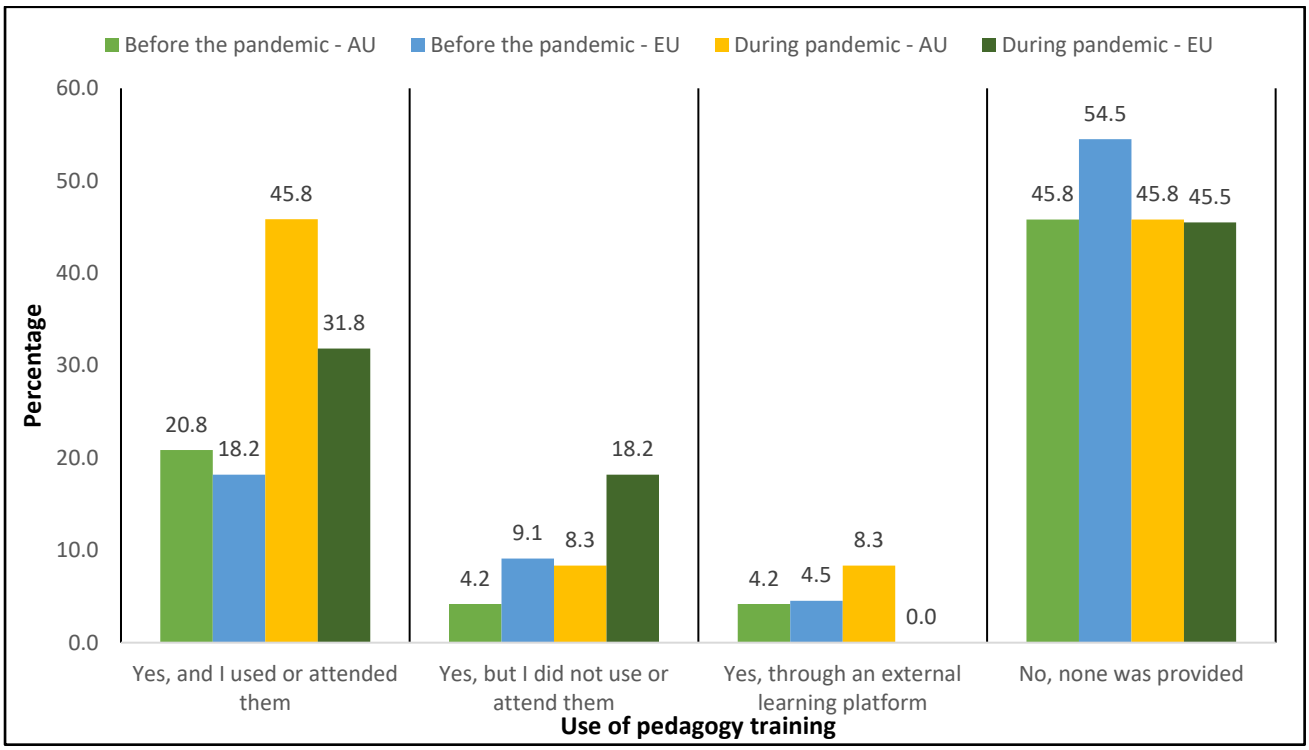

Figure 9: Did your university provide any pedagogy training to professors/lecturers on delivering lectures online before and during the pandemic? (n = 22)
Source: Data Analysis[15]

4.2.2 Students perception and use of online learning platforms and recorded online lectures

One of the key components of online studies is the course content being delivered via a platform which could be external or internal to the university. Table 5 shows that 43.52% and 73.17% of AU and EU students, respectively, stated that online course content was available to them and integrated as part of

[15] Most of the lecturers selected ***"not applicable"*** in the options which also mean that the training was not provided and in the three other options. For graphical representation purpose, the "not applicable" responses were divided into two – before and during the pandemic. The full result is available in the appendix section.

their university website. Many of the students (AU = 56.47% and EU = 87.18%) use the learning platform frequently while only 5.88% and 2.56% of the AU and EU students respectively did not use the platforms at all. Several authors have reported the use of various platforms, ranging from Moodle (Aristovnik et al., 2020; Makruf et al., 2022), learning management system (Dodson & Blinn, 2022; Ratnasingam et al., 2020), Webdoc (Yoon & Mecca, 2022), and WhatsApp (Anifowoshe et al., 2020) among others. More studies will be required to understand how effective it is to manage and use such platforms in teaching forest science.

The majority (55.12%) of the students stated that online classes are recorded in their universities, although at the discretion of the individual lecturer. Regarding the general use of the recordings, 57.59% and 25.95% of the students want *'class students should have access to the recordings'* and *'lecturers and the university should have access to the recordings',* respectively. On a personal level, 72.73% of EU students frequently watch the recordings, while 40.66% of AU have watched the recordings only on a few occasions. A larger proportion (61.74%) of all students want the recordings to be available perpetually, while another 19.13% want the recordings to be available between 3 and 6 months. Most students (57.78%) believe that the quality of class recordings can be improved, while 31.11% think that the quality is perfect. These results are in tandem with other similar studies (Aristovnik et al., 2020; Dodson & Blinn, 2021; Moosa, 2021; Prodjomaroeto & Muhyidin, 2021). Oginni et al., (2021) suggested that 'instead of having large lecture classes, the teaching could be recorded and shared with students, who would then come to small tutorial classes to better engage with the lecture content'.

Surprisingly, 81.15% of students want the on-line classes to be recorded, while only 9.02% of the students feel comfortable their voice and video are recorded with the lectures. This phenomenon has been confirmed by other studies, showing a reluctance of students to turn on their videos in online classes. In fact, one group of authors called it 'generation invisible' (Bedenlier et al., 2021). Some of the reasons include personal privacy, how others might perceive them, the sharing of personal background, the quality of internet connection, and not concentrating in class (Castelli & Sarvary, 2021; Tice et al., 2021).

Table 5: Student perception and use of online learning platforms and recorded online lectures

	Africa		Europe		Total	
Question	**n**	**%**	**n**	**%**	**n**	**%**
Did your university host the course content on any learning platform(s)?						
No, course content is not hosted online	17	15.74	2	4.88	19	12.75
Not applicable	6	5.56	0	0.00	6	4.03
Yes, integrated as part of university website	47	43.52	30	73.17	77	51.68
Yes, through an external learning platform.	38	35.19	9	21.95	47	31.54
Total	**108**	**100.00**	**41**	**100.00**	**149**	**100.00**
Did you use the learning platform(s) that your university hosted course content?						
No, I did not use them	5	5.88	1	2.56	6	4.84
Not applicable	4	4.71	0	0.00	4	3.23
Yes, I use them frequently	48	56.47	34	87.18	82	66.13
Yes, I use them rarely	28	32.94	4	10.26	32	25.81
Total	**85**	**100.00**	**39**	**100.00**	**124**	**100.00**
Do your lecturers record lecturers during online classes?*						
No, it is not allowed by my university	5	5.15	1	3.33	6	4.72
No, our platforms are not capable of recording	6	6.19	0	0.00	6	4.72
Yes, at the discretion of individual lecturers	54	55.67	16	53.33	70	55.12
Yes, but it depends on the platforms used	19	19.59	3	10.00	22	17.32
Yes, it is required by my university	13	13.40	10	33.33	23	18.11
Total	**97**	**100.00**	**30**	**100.00**	**127**	**100.00**
Which of the following statements are applicable to you as regards the recording of online classes?*						
I like the lectures to be recorded	72	80.90	27	81.82	99	81.15
I don't see the need for the lectures to be recorded	6	6.74	1	3.03	7	5.74
I feel comfortable if my voice and video are recorded with the lectures	6	6.74	5	15.15	11	9.02
Not applicable	5	5.62	0	0.00	5	4.10
Total	**89**	**100**	**33**	**100**	**122**	**100.00**
How do you want the classes recordings to be used?*						
Lecturers and the university should have access to the recordings	24	21.24	17	37.78	41	25.95
Class students should have access to the recordings	67	59.29	24	53.33	91	57.59
The recordings should be made public and perpetually for whosoever needs them	20	17.70	3	6.67	23	14.56
The recordings should be in the possession of the lecturer only	2	1.77	1	2.22	3	1.90
Not applicable	0	0.00	0	0.00	0	0.00
Total	**113**	**100**	**45**	**100**	**158**	**100.00**
How do you personally use the classes recordings?*						
The recordings are not available to students	17	18.68	1	4.55	18	15.93
I have never watched the recordings back	14	15.38	2	9.09	16	14.16
I have watched the recordings only on a few occasions	37	40.66	3	13.64	40	35.40
I frequently watch the recordings	22	24.18	16	72.73	38	33.63
Not applicable	1	1.10	0	0.00	1	0.88
Total	**91**	**100**	**22**	**100**	**113**	**100.00**
How long do you want the recordings to be available?						
1 – 2 months	6	6.98	2	6.90	8	6.96
3 – 6 months	13	15.12	9	31.03	22	19.13

7 – 12 months	7	8.14	6	20.69	13	11.30
Not applicable	1	1.16	0	0.00	1	0.87
Perpetually available	59	68.60	12	41.38	71	61.74
Total	**86**	**100**	**29**	**100**	**115**	**100.00**
Are you satisfied with the quality of the video recordings of online classes at your university?						
Maybe, the quality can be improved	53	55.21	25	64.10	78	57.78
No, the quality is poor	9	9.38	2	5.13	11	8.15
Not applicable	4	4.17	0	0.00	4	2.96
Yes, they are perfect	30	31.25	12	30.77	42	31.11
Total	**96**	**100**	**39**	**100**	**135**	**100.00**

*Multiple response question.

Source: Data Analysis

4.2.3 Virtual teaching options available to attend lectures and lecturers' choice of course delivery, recording of lectures and modifications of assignments

The lecturers were asked about the options available for students to attend lectures before and during the COVID-19 pandemic. The result shown in Figure 10 shows that there is a steady increase in the learning options available to students due to the pandemic. There is a massive increase in online synchronous learning from 4.5% before the pandemic to 77.3% during the pandemic for EU students. For the AU students, there is more flexibility, as 59.1% stated that students can choose to attend lectures online or face-to-face in class during the COVID-19 pandemic. The difference in flexibility of options before and during the pandemic is more pronounced in Europe than in Africa.

Students were also asked about the options available for students to attend lectures before and during the COVID-19 pandemic. The result shown in Figure 11 shows that the online synchronous option increased from 21.5% to 42.5% according to AU students during the COVID-19 pandemic. According to EU students, they have several options for attending lectures. The highest is Hybrid for all - a lecturer can teach students in a classroom via videoconferencing at 24.0%. The partial synchronous and partial asynchronous options also increased according to both AU (32.5%) and EU (15.0%) students. The difference in flexibility of options before and during the pandemic is also more pronounced in Europe than in Africa, as the lecturers attested.

The results of both the lecturers and students on the options available for teaching or learning are not unique for forestry education alone as similar pattern has been reported in various reports, including regional differences in the level of diversity of options (Alvarez & Corcuera, 2021; Gibbons, 2022; Makruf et al., 2022; Naicker et al., 2022; Younis & Elbanna, 2022).

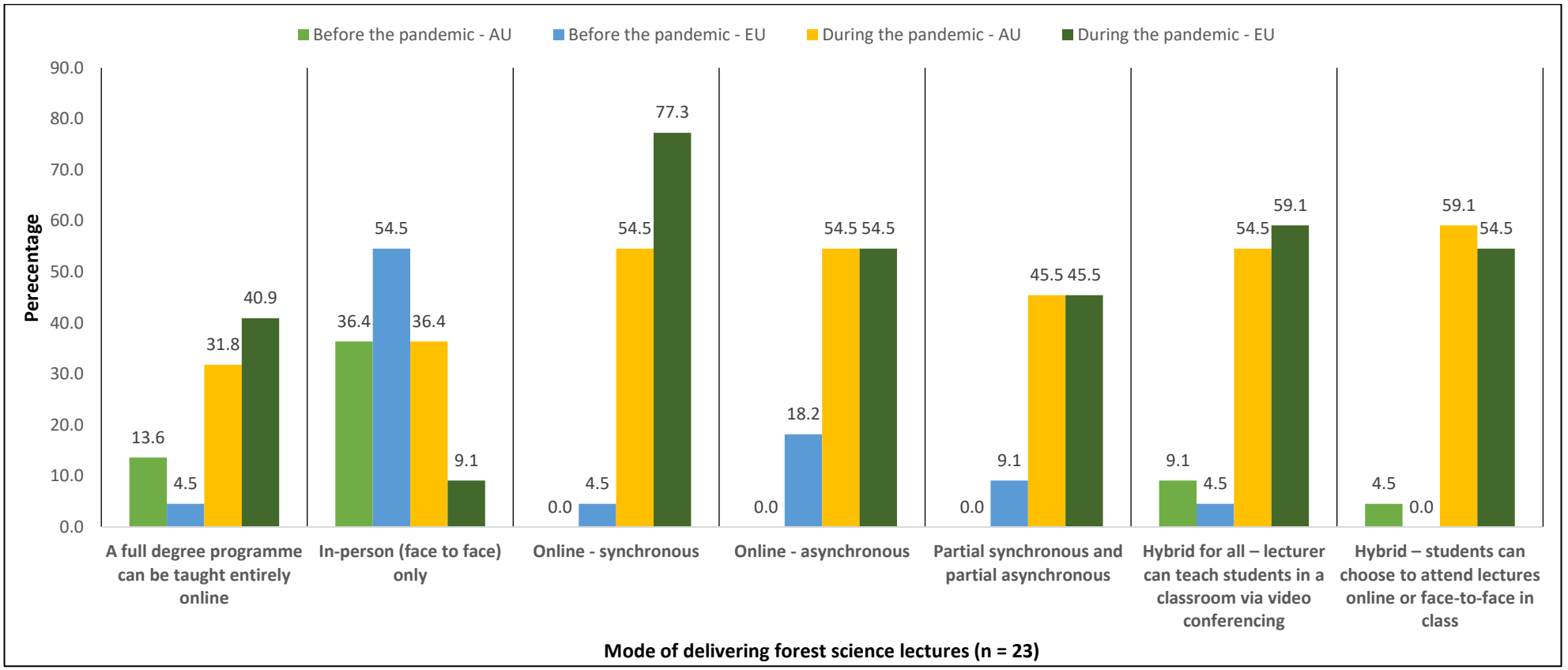

Figure 10: Which of the following options were available for students to attend lectures before and during the pandemic? (Lecturers, n=23)
Source: Data Analysis[16]

[16] The lecturers chose one of "Before the pandemic", "Before and during the pandemic", "During the pandemic", and "Not applicable" for each of the options provided. For graphical representation purpose, calculation was used to collapse the option to "Before the pandemic", and "During the pandemic". The "not applicable" responses were hidden from the graph for better understanding. The full result is available in Table at the appendix section.

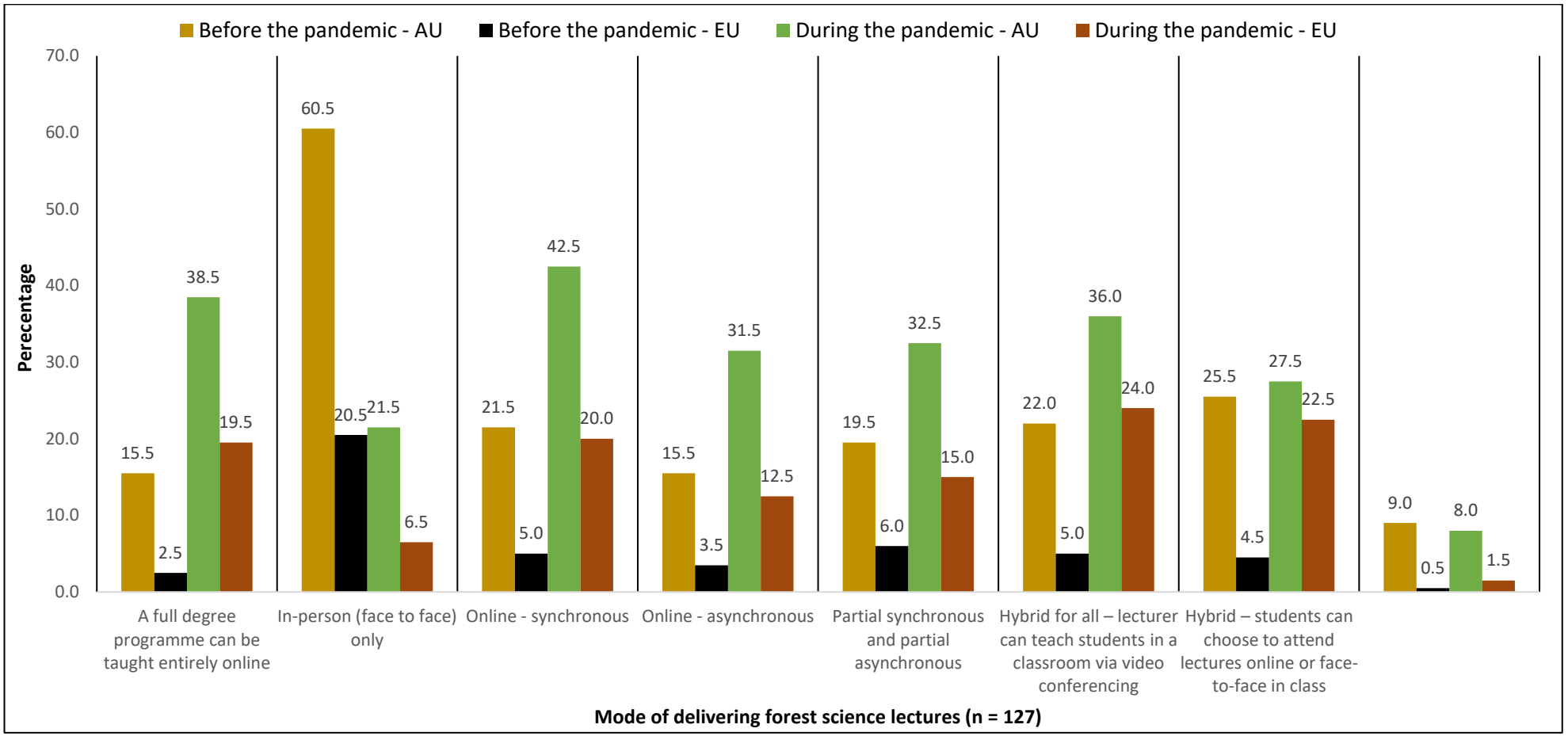

Figure 11: Which of the following options were available for students to attend lectures before and during the pandemic (students, n = 127)?
Source: Data Analysis[17]

[17] The students chose one of "Before the pandemic", "Before and during the pandemic", "During the pandemic", and "Not applicable" for each of the options provided. For graphical representation purpose, calculation was used to collapse the options to "Before the pandemic", and "During the pandemic". The "not applicable" responses were hidden from the graph for better understanding. The full result is available in Table at the appendix section.

Table 6 shows the responses on institutional freedom for course delivery due to the pandemic for the lecturers. For 58.33% of the AU lecturers, 45.45% of the EU lecturers stated 'Lecturers *can select the course modality but were encouraged to choose remote / online options'* while 'Remote / online *options compulsory for all courses"* – was stated by 45.45% of the EU lecturers. The reasons are not far-fetched. Europe was more hot by the pandemic than Africa, with Italy being in the top 25 of cumulative COVID-19 deaths per 100,000 population (Zhou et al., 2022). Lockdown measures are more stringent in Europe (Sobral et al., 2021) and Africa universities were less prepared to transition to virtual teaching (Abosede et al., 2021).

In recording their online classes, most of the lecturers record during their online classes either as a requirement by their university (31.82%) or at the discretion of the lecturers (59.09%). The top two reasons why the lecturers record their classes are for students to have access to go back to rewatch them later (55.17%), and for students missing the original presentation (37.93%). Different studies have confirmed the usefulness of recording online classes as they allow students to have the ability to rewatch them either because they originally missed the class, have an internet connection problem or other challenges, and for study purpose. The flexibility of using the recordings ultimately contributed to their academic success (Al-Hashmi, 2021; Alatni et al., 2021; Cahyadi et al., 2021; Dodson & Blinn, 2022; Erhan & Gümüş, 2020; Kolack et al., 2020).

Most lecturers (65.22%) partially modified the assignments given to students during the pandemic. On the reason for the modification of the assignments, the lecturers (AU = 23.08% and EU = 64.29%) stated that they adjusted the focus / length / structure of the assignments to account for the change in the delivery of the course. Forestry lecturers to be dynamic in the kind and length of assignments that they give their students (Dodson & Blinn, 2021, 2022).

Only 26.09% of all lecturers agree that their courses / modules that are still delivered exclusively face-to-face only despite the pandemic. It is not all bad for lectures to be offered in a variety of mediums, as students now have more flexibility on how they choose to attend lectures (either online or in-presence), this was not previously available for most forestry science students before the pandemic (Awan et al., 2021; Ngafeeson, 2021; UNESCO, 2020). These new technologies could strengthen virtual mobility in forest sciences (Tahvanainen, 2003) and be a baseline for preparing students to learn new technologies used in the forestry sector (Reynolds et al., 2005).

Table 6: Lecturers' choice of course delivery, recording of lectures, and modifications of assignments

Questions	Africa		Europe		Total	
	n	%	n	%	n	%
Institutional freedom for course delivery modality due to the pandemic for lecturers						
Lecturers can select course modality, but were encouraged to choose in-person options	1	8.33	1	9.09	2	8.70
Lecturers can select course modality, but were encouraged to choose remote/online options	7	58.33	1	9.09	8	34.78
Lecturers have complete freedom to select course modality (in-person, hybrid, remote/online)	0	0.00	2	18.18	2	8.70
Others (specify)	1	8.33	2	18.18	3	13.04
Remote / on-line options compulsory for all courses	3	25.00	5	45.45	8	34.78
Total	**12**	**100.00**	**11**	**100.00**	**23**	**100.00**
Do you record your lectures during online classes?						
No, I don't feel comfortable doing so	1	9.09	1	9.09	2	9.09
Yes, at the discretion of individual lecturers	5	45.45	8	72.73	13	59.09
Yes, it is required by my university	5	45.45	2	18.18	7	31.82
Total	**11**	**100.00**	**11**	**100.00**	**22**	**100.00**
Why do you record your lectures?*						
For students to have access to go back to re-watch them later	8	57.14	8	53.33	16	55.17
For students missing the original presentation	5	35.71	6	40.00	11	37.93
To make the lectures publicly available online, e.g., on YouTube	0	0.00	0	0.00	0	0.00
For my archival purpose	0	0.00	0	0.00	0	0.00
Others (specify)	1	7.14	1	6.67	2	6.90
Total	**14**	**100.00**	**15**	**100.00**	**29**	**100.00**
During the pandemic, did you modify your assignments every academic year as a lecturer?						
Partially	8	66.67	7	63.64	15	65.22
No	0	0.00	0	0.00	0	0.00
Yes	4	33.33	4	36.36	8	34.78
Total	**12**	**100**	**11**	**100**	**23**	**100.00**
What are some of the reasons behind the modification of assignments during the pandemic?*						
Added new assignments	1	7.69	0	0.00	1	3.70
Adjusted the assignment focus/length/structure to account for the change in the course delivery	3	23.08	9	64.29	12	44.44
Consolidated and reduced the number of assignments typically assigned	0	0.00	1	7.14	1	3.70
Typical tweaks I make to assignments every year	1	7.69	3	21.43	4	14.81
Others	8	61.54	1	7.14	9	33.33
Total	**13**	**100**	**14**	**100**	**27**	**100.00**
Despite the pandemic, are there courses / modules that are still exclusively face-to-face only?						
I don't know	8	66.67	4	36.36	12	52.17
No	1	8.33	4	36.36	5	21.74
Yes	3	25.00	3	27.27	6	26.09
Total	**12**	**100**	**11**	**100**	**23**	**100.00**

*Multiple response question.

Source: Data Analysis

4.3 Challenges faced and experienced forestry students and lecturers during the COVID-19 pandemic

This section discusses the result of the challenges faced and experienced during the COVID-19 pandemic by lecturers and students. The results and discussion were provided in two sub-sections.

4.3.1 General challenges faced by forestry students and lecturers during the COVID-19 pandemic

In Table 7, students were asked to rank on a 5-point Likert scale the general challenges faced during online learning during the COVID-19 pandemic. The top three ranking are missing the interactions they used to have with their colleagues and lecturers before and after lectures (mean = 4.28), followed by missing going on field trips (Mean = 4.27), and missing laboratory work (Mean = 4.00). Previous studies also confirmed that interactions are really essential for student learning experience, employability, motivation and success among others (Biyiri & Dissanayake, 2021; Bryson & Andres, 2020; Filho et al., 2021; Fuchs & Karrila, 2022; Kinnula et al., 2021; Scott & Willison, 2021).

Online communication also makes it easier for some to make easy connections and networking (Lambrechts et al., 2021). The inability of students to interact with each other and their lecturers face-to-face can negatively impact the development of important social skills that will be useful for their future employment. Different studies have confirmed this need for social skills for forestry students around the world and found it to be deficient in most university curricula. Therefore, the pandemic could further be compounding the problem (Bullard et al., 2014; De'Arman & York, 2021; Fouqueray & Frascaria-Lacoste, 2020; Mgaga & Scholes, 2019; Rekola et al., 2019; Sample et al., 2015; Villarraga-Flórez et al., 2016). Universities make plans to provide intensive training to their students who have missed face-to-face laboratory experience due to the pandemic (Hallal et al., 2020). Universities should incorporate laboratory and field trips in their forest education curriculums (Kachaka & Nkwinkwa, 2020; Kung'u et al., 2021).

In addition to the top three, there is also similarity in the ranking (9^{th} position) for both AU and EU students when it comes to losing access to university library resources. The use of the library is one of the reasons why students prefer on-campus studies (Rizun & Strzelecki, 2020; Twesige et al., 2021). On the other hand, the COVID-19 pandemic is helping to promote the development and expansion of digital and mobile libraries (EdTech Hub & eLearning Africa, 2020; Luchian, 2021). In regional contrast, African students ranks (4^{th}) not having free and fast Internet at home higher than their EU counterparts (11^{th}). The issue of underdevelopment of internet infrastructure in Africa has been

highlighted by other studies and there is a need to incorporate ICT into higher education in Africa (ADEA, 2020; Anifowoshe et al., 2020; Kachaka & Nkwinkwa, 2020; Kung'u et al., 2021).

Some other challenges expressed in words by students revolve around the financial burden of purchasing internet subscription, delayed graduation, difficulty in accessing class recordings, inability to request recommendation letters from professors, inability to really grasp difficult topics such as statistics, low level of concentration due to home chores, lack of motivation to pursue my degree, lecturers' ability to answer only a few of the students' questions. One of the students said 'Teaching *and learning facilities for me as a forestry student becomes limited, because for me, online classes are just formalities'.*

Table 7: General challenges faced by forestry students during online learning in the COVID-19 pandemic on a 5-point Likert scale

S/N	Challenges	AU		EU		Total		
		Mean	Rank	Mean	Rank	TLC	Mean	Rank
1.	I missed the interactions I used to have with my colleagues and lecturers before and after lectures	**3.60**	**1st**	**0.68**	**2nd**	920	**4.28**	**1st**
2.	I missed going on field trips	**3.54**	**2nd**	**0.73**	**1st**	917	**4.27**	**2nd**
3.	I missed laboratory work	**3.33**	**3rd**	**0.67**	**3rd**	859	**4.00**	**3rd**
4.	I missed the positive relationships I have with my professors	3.08	5th	0.59	4th	789	3.67	4th
5.	I had difficulties finding an internship/traineeship placement	3.07	6th	0.57	5th	784	3.65	5th
6.	I did not have free and fast internet at home	3.21	4th	0.41	11th	778	3.62	6th
7.	I had less access to career counselling and support services	3.00	7th	0.55	6th	764	3.55	7th
8.	I lost access to the university computer labs	2.90	10th	0.53	8th	739	3.44	8th
9.	I lost access to university library resources	2.92	9th	0.48	9th	731	3.40	9th
10.	I missed learning an important topic of interest because an entire course was cancelled due to Covid restrictions	2.93	8th	0.46	10th	727	3.38	10th
11.	I had a challenge preparing and taking examinations online	2.84	11th	0.54	7th	727	3.38	11th

n = 215 (AU = 180; EU = 35). Total Likert scale calculation (TLC).

Source: Data Analysis

The lecturers were asked to rank the general challenges faced during online teaching in the COVID-19 pandemic, and the results are presented in Table 8. It is nice to see that as students miss interactions, so do lecturers miss the interactions they used to have with students before and after lectures (mean = 3.87). The lecturers also had to stop field visits due to the pandemic (mean = 3.65); and their course load and work hours increased due to the pandemic (Mean = 3.39). No regional differences were

observed among the ranking provided by the lecturers. These challenges have been confirmed by forest operations instructors in a US survey (Dodson & Blinn, 2022).

Table 8: General challenges faced by lecturers during online teaching in the COVID-19 pandemic on a 5-point Likert scale

S/N	Challenges faced by lecturers during the COVID-19 pandemic	AU		EU		Total		
		Mean	Rank	Mean	Rank	TLC	Mean	Rank
1	I missed the interactions I used to have with the students before and after lectures	3.42	**1st**	4.36	**1st**		3.87	**1st**
2	Field visits due to the pandemic	3.25	**2nd**	4.09	**2nd**	89	3.65	**2nd**
3	My course load and work hours increased due to the pandemic	3.17	**4th**	3.64	**3rd**	84	3.39	**3rd**
4	I published fewer papers because it was not possible to collect primary data for more than 2 years	3.17	**4th**	3.55	**4th**	78	3.35	**4th**
5	Laboratory research had to stop laboratory research due to the lockdown	3.25	2nd	3.36	5th	77	3.30	5th
6	I had difficulties redesigning my academic work from face-to-face to online or mixed teaching mode	3.17	4th	3.36	5th	76	3.26	6th
7	I had a conflict with my official work and family responsibilities	2.67	7th	2.45	7th	75	2.57	7th
8	I got some income constraints because one of my courses was deleted, and I got lower salary	2.58	8th	1.64	8th	59	2.13	8th

n = 23 (AU = 12; EU = 11). Total Likert scale calculation (TLC)

Source: Data Analysis

4.3.2 Communication of experienced challenges during online education activities

Table 9 shows the result of some peculiar challenges experienced by students and asks if they reported it to their universities or not. The top three challenges experienced and communicated to the universities are studies/lab/fieldwork were delayed (22.79%), problems with Internet connection, i.e. availability, speed, reliability, etc. (16.28%), and they had trouble motivating themselves to attend online lectures, watch lectures videos, or complete an online assignment (10.7%). The students stated that they experienced some challenges but did not report to the universities, such as having difficulties in focus and time management (54.88%), trouble motivating themselves to attend online lectures, watch lectures videos, or complete an online assignment (47.44%), and experiencing difficulties with online learning because it does not match their learning style (45.58%). The challenges not experienced at all - contracting and recovering from COVID-19 virus disease (86.5%) topped the responses, followed by scholarship/funding being negatively affected (71.16%) and having problems with access to a working computer (58.14%).

In regional contrast (Table available in the Appendix), 91.67% of AU students do not experience contracting and recovering from the COVID-19 virus disease, while this number is 57.14% of the EU students. While more AU students (45.00%) experienced but were not communicated with their respective universities on problems with internet connection, i.e. availability, speed, reliability, etc., this number is only 17.14% for EU students. The proportion of EU students (25.71%) who experienced and reported to their respective universities contracting and recovering from the COVID-19 virus disease is higher than their AU counterparts (2.22%).

Some students expressed their challenges in writing, such as revisiting for internship after COVID-19; project, lab research failed, and study not funded. In the words of one - *"I asked for a psychology advisor, but the university did not accept non-Italian students for psychological services".* These challenges are not peculiar to forest sciences alone; they have been reported in other research related to virtual teaching. Universities have offered more advice, care, empathy, flexibility and understanding to students who have expressed a need for them (Cahyadi et al., 2021; Castelli & Sarvary, 2021; Cutri et al., 2020; Jeffery & Bauer, 2020; Kolack et al., 2020; Nöthling et al., 2022; Sansom, 2020; Simon et al., 2020; Sultanova et al., 2021). Students are encouraged to report the challenges they face during their studies to the universities. Furthermore, students have to be realistic about the support their lecturers and university can provide them in a difficult period such as the COVID-19 pandemic.

Table 9: Challenges experienced and communicated by students to the universities

S/N	Experiencing and communicating challenges to universities by the students	Not experience challenges		Experienced but not communicated challenges		Experienced and communicated challenges to the university	
		n	%	n	%	n	%
1	My studies/lab/fieldwork was delayed	74	34.42	92	42.79	49	**22.79**
2	I had problems with the Internet connection (availability, speed, reliability, etc.)	93	43.26	87	40.47	35	**16.28**
3	I was troubled motivating myself to attend online lectures, watch lectures videos, or complete my online assignment	90	41.86	102	**47.44**	23	**10.70**
4	I experienced difficulties with online learning because it does not match my learning style	95	44.19	98	**45.58**	22	10.23
5	I had problems with access to a working computer	125	**58.14**	70	32.56	20	9.30
6	My scholarship/funding was negatively affected	153	**71.16**	43	20.00	19	8.84
7	I had difficulties with focus and time management	80	37.21	118	**54.88**	17	7.91
8	I experienced loneliness or isolation because I could not have physical connections with other students/peers and/or friends/relatives	103	47.91	96	44.65	16	7.44

9	I contracted and recovered from COVID-19 virus disease	185	**86.05**	17	7.91	13	6.05

n = 215 (AU = 180; and EU = 35).

Source: Data Analysis

Table 10 presents the report of the lecturers on the challenges they might experience while teaching online due to the COVID-19 pandemic and if they report them to their universities. Many of the lecturers (47.83 - 73.91%) have not experienced the common challenges listed in the questionnaire. Not all challenges experienced are communicated to the universities, as 43.48% of the lecturers stated, experiencing delay in their research/lab/fieldwork; experiencing loneliness or isolation with the lockdown and restrictions; and having trouble motivating their students to attend lectures, watch lecture videos or complete an online assignment. Difficulties with focus and time management (21.74%); and experiencing difficulties organizing examinations online (13.04%) are challenges experienced and reported by the lecturers.

Suspension, modification of exams into assignments and adaptation of physical examinations to electronic oral examinations are some of the repeated themes about student examination in higher education due to the COVID-19 pandemic. Aside from technical difficulties, some success has been recorded, though there are still ethical concerns about monitoring of exams. Students have also been reported to pass their studies on average with higher marks before and during the COVID-19 pandemic. It is recommended that forestry curriculum should be flexible to allow a variety of examination modes, and universities should train lecturers on how to conduct effective virtual examinations (Ajagbe et al., 2021; Aristovnik et al., 2020; Awan et al., 2021; Dietrich et al., 2020; Jacob, 2020; Jacob et al., 2021; Makruf et al., 2022; Twesige et al., 2021).

Regarding regional differences (Table available in the Appendix), difficulties with focus and time management were not a challenge for 91.67% of AU and 36.36% of EU lecturers. Experiencing loneliness or isolation with the lockdown and restrictions; and having trouble motivating students to attend lectures, watch lecture videos, or complete my online assignment were challenges experienced by the lecturers (16.67% AU, and 72.73% EU), but were not communicated to their respective universities. Having difficulties with focus and time management (45.45%); and having difficulties with delivering their lectures online because it does not match their teaching style (18.18%) are the challenges faced and communicated to their respective universities among the EU lecturers, while these are not challenges for the AU lecturers (0.00%). Pedagogy dissatisfaction has been reported among lecturers (Sansom, 2020). It is quite unfortunate that most of the research conducted on virtual

teaching has focused more on students and their satisfaction and fewer desire to understand challenges faced by lecturers (Aristovnik et al., 2020; Biyiri & Dissanayake, 2021; Fuchs & Karrila, 2022; Shyju et al., 2021; Sun et al., 2008; Zhang et al., 2021). Therefore, I recommend that further studies be carried out on the perception and experience of this important topic on virtual teaching in forest science (Cutri et al., 2020; Leiba & Gafni, 2021; Sample et al., 2015; Sansom, 2020).

Table 10: Challenges experienced and communicated by lecturers to the universities (n = 23)

S/N	Experiencing and communicating challenges to universities by the students	Not experienced challenges		Experienced but not communicated challenges		Experienced and communicated challenges to the university	
		n	%	n	%	n	%
1	I had difficulties with focus and time management	15	**65.22**	3	13.04	5	**21.74**
2	I had difficulties organizing examinations online	14	**60.87**	6	26.09	3	**13.04**
3	I experienced a delay in my research/lab/fieldwork	11	47.83	10	**43.48**	2	8.70
4	I had difficulties delivering my lectures online because it does not match my teaching style	14	**60.87**	7	30.43	2	8.70
5	I experienced loneliness or isolation with lockdown and restrictions	11	47.83	10	**43.48**	2	8.70
6	I had trouble motivating my students to attend lectures, watch lecture videos, or complete my online assignment	11	47.83	10	**43.48**	2	8.70
7	I have contracted and recovered COVID-19 virus myself	15	**65.22**	7	30.43	1	4.35
8	My research funding has been negatively affected	17	**73.91**	6	26.09	0	0.00

Source: Data Analysis

4.4 Prospects of online teaching and learning of forest sciences after the COVID-19 pandemic

The students were asked to rank their perceptions about some prospects of learning forest science online on a 5-point Likert scale. The top four ranking prospects according to Table 11 are - the pandemic has helped the students to enhance their soft skills such as collaboration, working in a team, use of ICT tools etc. (mean = 3.93); the opportunity to combine studies and work (mean = 3.70); and the students have opportunity to participate in more extra-curricular activities e.g., voluntary activities (Mean = 3.65); and the pandemic has opened the opportunity to introduce new and emerging topics such as Greencare, forest, and human health, etc. to the students (mean = 3.65).

This study confirms that the use of virtual teaching has helped to strengthen the student's soft skills and gain experience through volunteering, therefore contributing to future employability prospects for forestry graduates and to succeed at their jobs (Cheang & Yamashita, 2020; EFI et al., 2022; Kammesheidt et al., 2007; Kelly & Brown, 2019; Ramcilovic-Suominen et al., 2016; Rekola et al., 2017, 2018, 2019; Sample et al., 2015; Scott & Willison, 2021; T. Wilson, n.d.). The COVID-19 pandemic has also helped to popularize new topics such as Greencare, forest, and human health, leading to more diverse career opportunities for forestry graduates especially in the green jobs and bioeconomy sectors (Consoli et al., 2016; Da Silva & Schweinle, 2022; Doimo et al., 2021; EFI et al., 2022; FAO, 2020a; FAO & UNECE, 2018; Larasatie et al., 2020; Masiero et al., 2020).

The least three rankings for the students are, preferring virtual reality (VR)/ online teaching to replace some fieldwork (mean = 2.40); preferring online teaching method and use of video conferencing tools in compared to face-to-face only because they allow invitation and presence of guest lecturers from other universities/institutions (Mean = 2.66); and having the opportunity to avoid professors they have negative relationships with (Mean = 2.69).

Virtual reality (VR) is a simulation of a real-world situation and could be a substitute for field trips which cost more money, personnel and time, the prospects are still unfolding (Cheng, 2021; Weerawardane, 2021). However, this study confirms that forestry students are not ready for such a means of learning right now. Universities should consider designing VR-based learning systems for forest science with easy, useful and enjoyable functions to encourage students to use (Wang et al., 2022). Students also care less about invitation of guest lecturers via video conferencing compared to face-face classes and they generally have a more positive relationship with their professors. However, the COVID-19 pandemic has allowed lecturers to involve guest lecturers and enrich course contents as there is no need to travel cost and plan (Ameyaw et al., 2019; Dodson & Blinn, 2021).

In regional contrast, AU students ranked having the opportunity to participate in more extracurricular activities, e.g. voluntary activities, and having flexible study hours due to online teaching methods 3rd (Mean = 3.87) and 5th (Mean = 3.17), respectively, while the EU students ranked them 7th (Mean = 2.51) and 1st (Mean = 3.34) positions, respectively. On regional similarities, both AU (Mean = 2.54) and EU (Mean = 1.71) students ranked them with the preference of virtual reality (VR) / online teaching to replace some fieldwork lastly (9th position). These differences are not unusual based on the social and technical context of the educational opportunities offered on both continents.

Some other prospects of virtual learning in the words of the students (only Africans responded) are – *'If online studies are to be adopted, then there's is need to reduce tuition"*; *"Many topics were covered in the shortest time possible"*; *"Opportunity to have fun with family"*; *"Pandemic has exposed students to the real work outside the university walls";* and *"Putting into consideration the way of learning in my university where we have more theory than practical, virtual learning is still okay because there is no develop equipment to learn the real practical of field work'.*

Table 11: Perception of students about the prospects of learning forest science online on a 5-point Likert scale

S/N	Prospects of online learning	AU		EU		Grand total		
		Mean	Rank	Mean	Rank	TLC	Mean	Rank
1	The pandemic has helped students to improve their soft skills such as collaboration, working in a team, use of ICT tools etc.	4.05	**1st**	3.29	**3rd**	844	3.93	**1st**
2	I have the opportunity to combine studies and work	3.92	**2nd**	2.57	6th	796	3.70	**2nd**
3	I have the opportunity to participate in more extracurricular activities, e.g., voluntary activities e.g., voluntary activities	3.87	**3rd**	2.51	7th	784	3.65	**3rd**
4	The pandemic has opened the opportunity to introduce new and emerging topics such as Greencare, forest, human health, etc. to students	3.66	4th	3.60	**1st**	784	3.65	**3rd**
5	I now have flexible study hours due to online teaching methods	3.17	5th	3.34	**2nd**	687	3.20	5th
6	I prefer online teaching/learning platforms to face-to-face only because they allow us as students to collaborate with peers at other universities and locations	2.66	7th	2.91	4th	581	2.70	6th
7	I had the opportunity to avoid professors with whom I have negative relationships with	2.79	6th	2.14	8th	578	2.69	7th
8	I prefer the online teaching method and the use of video conferencing tools in compared to face-to-face only because they allow invitation and presence of guest lecturers from other universities/institutions	2.63	8th	2.80	5th	572	2.66	8th
9	I prefer virtual reality (VR)/online teaching to replace some fieldwork	2.54	9th	1.71	9th	517	2.40	9th

n = 215 (AU = 180; and EU = 35). Total Likert scale calculation (TLC)

Source: Data Analysis

The results in Table 12 show that the top three teaching activities explored by universities since the beginning of the pandemic according to students are the use of videos to replace some field concepts (29.23%); invitation of guest lecturers from other universities and research institutions (20.42%); and

invitation of guest lecturers from forestry companies and organizations (12.32%). There is no significance in the results at the regional level.

Students have been reported to prefer a flexible student-centered learning approach over the use of recorded video or Zoom meetings to learn wood science in Malaysia. The ease of using online learning platform reduce over more practical courses (Ratnasingam et al., 2020). Additionally, viewing a pre-recorded informational video on forestry positively affects the perception of over 1,000 undergraduate students in 18 United States of America universities on urban forestry as a career path (O'Herrin et al., 2018). In my own personal view, guest lecturers could be future employers and collaborators if students maximize it. For example, I interned in a research institute where we have guest lecturers in my first year of Masters.

The top three reported examination modes explored by their universities since the beginning of the pandemic according to students are the exams are conducted face-face (39.37%); nothing has changed in the university examination techniques (26.5%); and exams are conducted entirely online through structured questions on an online platform (11.75%). For regional difference, 32.2% of AU students reported that nothing has changed in their university exam techniques, while only 4.62% of EU students reported the same. On the contrary, 29.23% and 26.15% of EU students reported that their exams are conducted entirely online through structured questions on an online platform; and exams conducted entirely online in an interview style, respectively, while only 7.20% and 4% of AU students reported the same.

This study shows that the use of online examination methods is still very minimal in forest science programs. It has been reported that the use of online examinations is not very efficient and there is a need for more improvement in such technologies coupled with better ICT infrastructure to make them scalable on a wider university scale and a need for training lecturers on online assessment (Ajagbe et al., 2021; Makruf et al., 2022; Montenegro-rueda et al., 2021; Twesige et al., 2021; Weerawardane, 2021).

Table 12: Students' reports on explored teaching activities and examination modes

	Africa		Europe		Total	
Question	**n**	**%**	**n**	**%**	**n**	**%**
Which of the following teaching activities has your university explored since the beginning of the pandemic?*						
Videos used to replace some field concepts	63	**30.73**	20	**25.32**	83	**29.23**

Invited Guest Lecturers from other universities and research institutions	36	**17.56**	22	**27.85**	58	**20.42**
Invited Guest Lecturers from forestry companies and organizations	23	11.22	12	**15.19**	35	12.32
Facilitating interuniversity collaboration of lecturers and students within my country	19	9.27	6	7.59	25	8.80
Facilitating interuniversity collaboration of lecturers and students internationally	20	9.76	12	**15.19**	32	11.27
Explored the intersections of forest and COVID-19 in my research	40	**19.51**	7	8.86	47	**16.55**
Others (specify)	4	1.95	0	0.00	4	1.41
Total	**205**	**100.00**	**79**	**100.00**	**284**	**100.00**
Which of the following examination modes have been explored in your university since the beginning of the pandemic as a student?*						
My exams are conducted face-face	102	40.80	22	33.85	124	39.37
Exams conducted entirely online in an interview style	10	4.00	17	26.15	27	8.57
Exams conducted entirely online through structured questions on an online platform	18	7.20	19	29.23	37	11.75
Fewer or shorter exams are conducted	17	6.80	3	4.62	20	6.35
Exams eliminated entirely	14	5.60	1	1.54	15	4.76
Nothing has changed in my university examination techniques	80	32.00	3	4.62	83	26.35
Both physical and online exams	2	0.80	0	0.00	2	0.63
Continuous assessments were conducted online, while the examination is usually conducted using pen and paper	1	0.40	0	0.00	1	0.32
The exams were not conducted at all	1	0.40	0	0.00	1	0.32
Adequate physical spacing in face-face exams	3	1.20	0	0.00	3	0.95
Field work and case study reports	1	0.40	0	0.00	1	0.32
An exam online just for one course	1	0.40	0	0.00	1	0.32
Total	**250**	**100.00**	**65**	**100**	**315**	**100**

*Multiple response question.

Source: Data Analysis

Table 13 shows the results on the perceptions of lecturers about the prospects of teaching forest science online based on ranking on a 5-point scale. The top three results are – experimenting with new tools and teaching approaches (Mean = 4.14); the use of virtual teaching tools has forced/helped teachers/professors to innovate, learn new techniques and software and skills as professors (Mean = 4.00); and participating in academic conferences is now easier and cheaper through online platforms (Mean = 3.77).

The three low-ranking prospects are professors having the opportunity to avoid students with whom they have negative relationships (Mean = 1.50); preferring virtual reality (VR)/online teaching to replace some fieldwork (Mean = 1.50); and prefer online teaching methods and use of video conferencing tools compared to face-to-face only because they allow invitation and presence of guest lecturers from other universities/institutions (Mean = 1.93). There are regional differences in the ranking, though the positions are not far from each other. However, participating in academic

conferences is now easier and cheaper through online platforms and was ranked third (3rd) by both AU and EU lecturers.

Table 13: Perception of lecturers about the prospects of teaching forest science online on a 5-point Likert scale

S/N	Prospects	AU		EU		Total		
		Mean	Rank	Mean	Rank	Sum	Mean	Rank
1	I have experimented with new tools and teaching approaches	4.50	**3rd**	4.00	**1st**	58	4.14	**1st**
2	The use of virtual teaching tools has forced/helped teachers/professors to innovate, to learn new techniques, software, and skills as professors	4.50	**3rd**	3.80	**2nd**	56	4.00	**2nd**
3	Participating in academic conferences is now easier and cheaper through online platforms	4.50	**3rd**	3.44	**3rd**	49	3.77	**3rd**
4	The pandemic has helped students to improve their soft skills such as collaboration, working in a team, use of ICT tools etc.	4.75	**2nd**	3.22	4th	48	3.69	4th
5	The pandemic has opened the opportunity to introduce new and emerging topics such as Greencare, forest and human health, etc. to students	5.00	**1st**	2.44	6th	42	3.23	5th
6	I now have flexible working hours due to online teaching methods	2.50	7th	2.67	5th	34	2.62	6th
7	I prefer online teaching/learning platforms to learning only because they allow students to collaborate with peers at other universities and locations	2.75	6th	2.00	7th	31	2.21	7th
8	I published more papers because of more time available	2.50	7th	1.90	8th	29	2.07	8th
9	I prefer the online teaching method and the use of video conferencing tools in compared to face-to-face only because they allow invitation and presence of guest lecturers from other universities/institutions	2.00	9th	1.90	8th	27	1.93	9th
10	I prefer virtual reality (VR)/online teaching to replace some fieldwork	1.25	10th	1.60	11th	21	1.50	10th
11	I had the opportunity to avoid students with whom I have negative relationships with	1.00	11th	1.63	10th	15	1.50	10th

n = 23 (AU = 12; and EU = 11).

Source: Data Analysis

The lecturers were asked if they had explored some teaching activities or examination mode since the beginning of the pandemic. The results in Table 14 show that the top three teaching activities explored are using videos to replace some field concepts (22.22%); having been involved in an interuniversity

collaboration of lecturers and students internationally (16.67%); and having researched the intersection of forest and health in my research (16.67%). Regarding regional differences, more AU lecturers (26.67%) have collaborated with more researchers outside their institution than previously than the EU lecturers (4.76%). On the other hand, more EU lecturers (23.81%) have researched the intersection of forest and human health in their research than AU lecturers (6.67%).

Wood science and technology lecturers prefer recorded lectures and recorded videos as the most common method for teaching online in a Malaysian survey (Ratnasingam et al., 2020). The use of video to teach forest education and other university courses has also been reported in other studies (Dodson & Blinn, 2021; Larsen et al., 2020; Rodríguez-Piñeros et al., 2020). International research and project collaboration is the basis of good forestry science and research, as forests are being more interconnected and several international policies affect forests on a national and local basis. Therefore, it is imperative that students and lecturers connect with others to share experiences and how our forests can be better managed (Rodríguez-Piñeros et al., 2020; Zeng et al., 2020). It is not surprising that lecturers at European universities are already researching the intersection of forest and human health as it is already becoming a popular field with heightened awareness during COVID-19 pandemic, especially on the use of green places during the lockdown (Bamwesigye et al., 2021; FAO, 2020a; FAO & UNECE, 2018; Frakes et al., 2022; Jarský et al., 2022; Talal & Gruntman, 2022; Weinbrenner et al., 2021). About 232 Greencare initiatives have been reported in Italy alone (Doimo et al., 2021), thus, the importance of forests to contribute to green recovery is being increasingly recognized (FAO, 2022b).

On conducting of examinations, the top three responses are: exams are conducted face-face (30.43%), exams are moved entirely online in an interview style (26.09%), and exams are moved entirely online through structured questions on an online platform (17.39%). On regional difference, none of the AU lecturers (0.00%) have given fewer or shorter exams; have eliminated exams entirely; or parts of the exams are conducted face-to-face, others online while none of the EU lecturers (0.00%) have eliminated exams entirely. It is also observed that while half of the AU lecturers (50.00%) conduct their exam face-to-face, less than a quarter of the EU lecturers (23.53%) do the same.

Since the beginning of the COVID-19 pandemic, examinations have been conducted in the form of assignments, oral examination, structured online test, reports (Dietrich et al., 2020; Dodson & Blinn, 2021; Makruf et al., 2022) and in worst case cancelled or suspended (Twesige et al., 2021; UNESCO et al., 2021). Electronic examination has its own challenges such as limited to poor internet access, unreliable power supply, unsupportive educational policies, fear of examination malpractices, and

inadequate technical infrastructure (Ajagbe et al., 2021; Huang, 2020). We need just beyond the transition but transformation and diversification of assessment methods (O'Neill & Padden, 2022; Weerawardane, 2021). Regional differences are expected based on their level of development and institutional policies.

Table 14: Explored teaching activities and examination modes among lecturers

	AU		EU		Total	
Explored teaching and examination modes among lecturers	**n**	**%**	**n**	**%**	**n**	**%**
Which of the following teaching and research activities have you explored since the beginning of the pandemic as a lecturer?*						
I have used videos to replace some field concepts	3	**20.00**	5	**23.81**	8	**22.22**
I have invited guest lecturers from other universities and research institutions	1	6.67	3	14.29	4	11.11
I have invited guest lecturers from companies and organizations	0	0.00	1	4.76	1	2.78
I have been involved in an interuniversity collaboration of lecturers and students within my country	2	13.33	1	4.76	3	8.33
I have been involved in an university collaboration of lecturers and students internationally	3	**20.00**	3	**14.29**	6	**16.67**
I have collaborated with more researchers outside my institution than previously	4	**26.67**	1	4.76	5	13.89
I have researched the intersection of forest and human health in my research	1	6.67	5	**23.81**	6	**16.67**
I have explored the intersections of forest and COVID-19 in my research	1	6.67	0	0.00	1	2.78
Photography	0	0.00	1	4.76	1	2.78
Virtual tours	0	0.00	1	4.76	1	2.78
Total	**15**	**100**	**21**	**100**	**36**	**100.00**
Which of the following examination modes have you explored since the beginning of the pandemic as a lecturer?*						
My exams are conducted face-face	3	**50.00**	4	**23.53**	7	**30.43**
I moved my exams entirely online in an interview style	1	**16.67**	5	**29.41**	6	**26.09**
I moved my exams entirely online through structured questions on an online platform	1	**16.67**	3	**17.65**	4	**17.39**
I gave fewer or shorter exams	0	0.00	2	11.76	2	8.70
I have eliminated exams entirely	0	0.00	0	0.00	0	0.00
Nothing has changed in my examination techniques	1	**16.67**	1	5.88	2	8.70
Parts of my exams are conducted face-to-face, others online	0	0.00	2	11.76	2	8.70
Total	**6**	**100**	**17**	**100**	**23**	**100**

*Multiple response question.

Source: Data Analysis

4.5 Looking beyond teaching and learning forest science in the COVID-19 pandemic era

Table 15 shows the ranking of opportunities and challenges that can arise in the future based on teaching and learning forest science in the COVID-19 pandemic era in the perspective of all respondents. The top three ranking are as follows: they would appreciate it if international exchange

programmes could be initiated for forestry students and lecturers face-face (Mean = 4.11), felt that new jobs and career prospects will be available in the forest sector generally, e.g., Greencare (Mean = 4.09); they would appreciate it if intercontinental exchange programs could be initiated for forestry students and lecturers virtually (Mean = 3.84). Now is the right time for universities to foster collaboration that could lead to exchange of students both virtually and face-to-face intercontinental wise as they are in high demand by the respondents. Such initiatives have been carried out in the past and they have contributed to exchange of knowledge, collaborative research, and even curriculum review (Ameyaw et al., 2019; Arevalo et al., 2014; Längin et al., 2004; Zeng et al., 2020). The COVID-19 pandemic will help create more job possibilities/opportunities for forestry graduates especially in areas not previously and fully explored such as Greencare, forest and human health, forest and zoonotic disease, the one health approach, sustainable bioeconomy, etc. (Adhikari & Ozarska, 2018; Doimo et al., 2021; FAO, 2020a; Macht et al., 2022; UNEP, 2020).

The least three classifications are the feeling that teaching and learning forest science in the era of the pandemic will negatively impact the ability of forestry graduates to find a job (employability) in the next 5 years (mean = 2.95); feeling that new forest science graduates will not be recognized as well-prepared and qualified professionals (mean = 3.15); and the feeling that the generation of forestry students taught during the pandemic will have weaker social and soft skills (mean = 3.28). The issues of employability (Arevalo et al., 2010; Kung'u et al., 2021; Ramcilovic-Suominen et al., 2016; Rekola et al., 2018; Rekola & Lautanen, 2015; Robredo, 2010); Professionalization (Arevalo et al., 2010; Innes & Ward, 2010; Jegatheswaran et al., 2018; Rekola et al., 2010; Shirley et al., 2010; Walmsley, 2016); and social skills (Fouqueray & Frascaria-Lacoste, 2020; Mgaga & Scholes, 2019; Sample et al., 2015; Villarraga-Flórez et al., 2016) have been well documented in forest education research. However, these concerns are less worry or will not negatively impact forestry graduates produced during the COVID-19 pandemic according to the respondents. It is too early to determine this, as future studies will be needed to confirm the situation.

No regional similarities were observed, but differences. The EU respondents ranked the feeling that the quality of forest education provided during the pandemic was compromised due to the shift to online teaching as second (3.65) while the AU respondents ranked it fifth (mean = 3.7). The EU respondents ranked the feeling that the generation of forestry students taught during the pandemic will have weaker social and soft skills 7^{th} (mean 3.26) while the AU respondents ranked it 11^{th} (Mean = 3.28). It is not surprising that European respondents feel that the quality of forest education provided during the pandemic was compromised as there were usually more field trips than are currently available. For example, the only field trip that was planned for my second year at the University of

Padova, Italy was cancelled as a substantial proportion of students and some lecturers tested COVID-19 positive few days before the trip. In my first year in University of Lleida, Spain, the lecturers should put social distancing in place in planning field trip such as taking only two students per car or fewer persons in a bus. Social interactions among students and lecturers were reduced during the pandemic in Europe, too, thus the projection for weaker social skills.

Table 15: Looking beyond teaching and learning forest science in the COVID-19 pandemic era on a 5-point Likert scale

S/N	Looking beyond teaching and learning forest science in COVID-19 pandemic era	AU			EU			Total		
		Sum	Mean	Rank	Sum	Mean	Rank	Sum	Mean	Rank
1.	I would appreciate if intercontinental exchange programmes could be initiated for forestry students and lecturers face-face	792	4.13	2nd	187	4.07	1st	979	4.11	1st
2.	I think that new jobs and career prospects will be available in the forest sector generally, e.g. Greencare	816	4.25	1st	157	3.41	6th	973	4.09	2nd
3.	I would appreciate if intercontinental exchange programmes could be initiated for forestry students and lecturers virtually	748	3.90	3rd	166	3.61	4th	914	3.84	3rd
4.	I think that the generation of forestry students taught during the pandemic will have better ICT and computer skills	727	3.79	4th	167	3.63	3rd	894	3.76	4th
5.	I think the quality of forest education delivered during the pandemic was compromised due to the shift to online teaching	711	3.70	5th	168	3.65	2nd	879	3.69	5th
6.	I think the university has done its best to help graduates transition to the real world of the forest profession despite the pandemic	697	3.63	6th	160	3.48	5th	857	3.60	6th
7.	I think the students have acquired limited knowledge due to pandemic	701	3.65	7th	147	3.20	8th	848	3.56	7th
8.	I think that the generation of forestry students taught during the pandemic will have weaker technical skills	688	3.58	8th	145	3.15	9th	833	3.50	8th
9.	I think that this virtual teaching of forest science will also negatively affect the way forests are managed and will be managed	657	3.42	9th	141	3.07	10th	798	3.35	9th
10.	I think more future forestry professionals would like to work more indoor	651	3.39	10th	135	2.93	12th	786	3.30	10th
11.	I think that the generation of forestry students taught during the pandemic will have weaker social and soft skills	630	3.28	11th	150	3.26	7th	780	3.28	11th
12.	I think that new forest science graduates will not be recognized as well-prepared and qualified professionals	611	3.18	12th	138	3.00	11th	749	3.15	12th
13.	I believe that teaching and learning forest science in the era of the pandemic will negatively impact the ability of forestry graduates to find a job (employability) in the next 5 years	573	2.98	13th	129	2.80	13th	702	2.95	13th

n = 238 (AU = 192; and EU = 46).

Source: Data Analysis

As a follow-up and open-ended question, respondents were also asked to optionally provide other direct and short-term outcomes of the pandemic on forest education. Most of the (8 of 11) comments revolve around compromised learning and fewer field trips. Limited internship period, stress-relieving learning, and mixed feelings. Only one lecturer made a comment. The complete statements are presented in Table 16.

Table 16: Direct and short-term outcomes of the COVID-19 pandemic on forest education

Summary	**Respondents comment on direct and short-term outcomes of the COVID-19 pandemic on forest education**
Compromised learning and less field work (8)	*As forests to need also be studied at the spot, the Covid pandemic did compromise the field-trip kind of learning, where one is in touch with the forest.*
	I did not learn anything
	Forest science has a lot to do with field work beyond classrooms, and these field work works were hindered and not carried out during the pandemic. This, I will negatively affect forest science learning during the pandemic.
	Less opportunity for students to learn in a pragmatic manner.
	The pandemic tried to turn a practical base discipline into a theory which has negatively impacted learning outcomes.
	More practical work is needed.
	The pandemic caused negativity and low levels of willingness toward forest activities. **- Lecturer**
	Practical lessons reduced
Internship affected (1)	*Limited internship time*
Stress relieving (1)	*Online classes are stress relieving*
Mixed feeling (1)	*Firstly, it creates anxiety and depression when I was unable to a visa appointment, but later when I arrived in Viterbo, I am amazed by their cooperation and I am so grateful about how they treat me as my family and guide.*

Source: The comments

Overall Perspective of Learning Forest Sciences in the COVID-19 pandemic era

The students were asked to describe their overall perspective of learning forest sciences in the era of the COVID-19 pandemic. The result is presented in a word cloud (Figure 13) and Table 17, showing that 87 students (52.10%) were negative and 80 students (47.90%) were positive about their overall experience. Thus, more students give a negative perception.

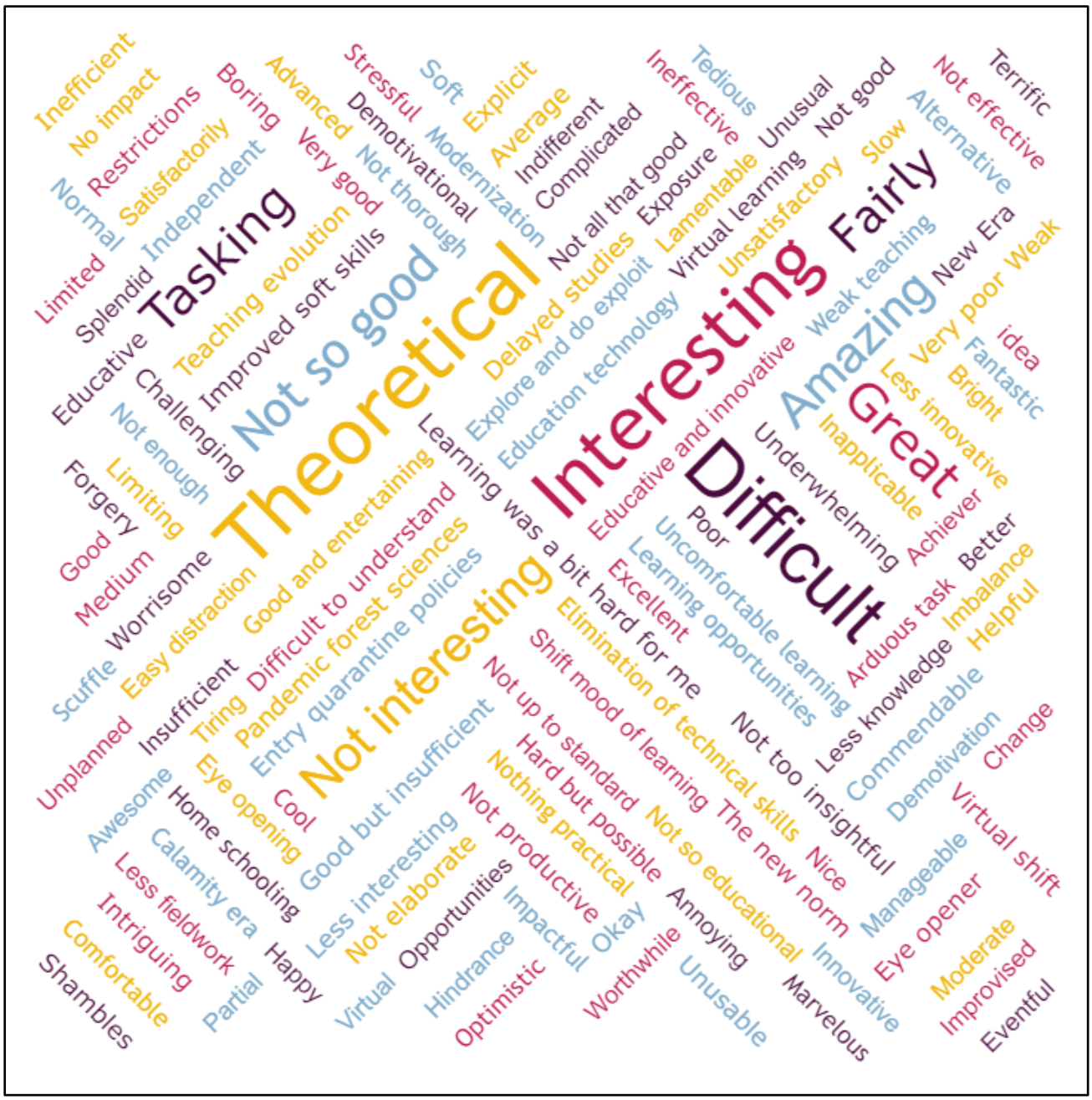

Figure 12: Word cloud of general student perspective on learning forest sciences in the COVID-19 pandemic era
Source: Respondents Comment

Table 17: Students comment on the general perspective of learning forest sciences in the COVID-19 pandemic era

Summary	Students comment on the general perspective of learning forest sciences in the COVID-19 pandemic era
Positive (12)	*I have learnt a lot of things about forest science and am glad.*
	I love forestry because I have learnt many things
	It helped improve my soft skills and it made me do more research on my own.
	It was an amazing time and I really enjoyed it.
	It was better to what was shown in class
	It was in many an eye opener to many learning styles and opportunities
	It wasn't that bad in as much as you can provide time to practice what you've learnt virtually
	Learning forestry took a big shift as it exposed me to opportunities outside my university and home country and also gave me access to new knowledge and how Forest science is related to the pandemic.
	My overall perspective of learning in the pandemic era has clearly revealed the importance of technology and the impact on education.
	Passion to find solutions to world problems
	Satisfactory however for Forestry to be better understood, there is for field works/trip and laboratory work too
	The university and staff all are working together in same platform and very cooperative though its covid pandemic time
Negative (14)	*Almost affect teaching and learning in higher education*
	Because of the pandemic learning forest science has become difficult for our rural youths
	Closing of the school at the time without online classes
	Comfortable but not fully beneficial
	Feel bad for not coming to school and sitting in the classroom
	Forest sciences learning have a lot to do with field work, which I believe was greatly negatively affected during the pandemic era
	I found it difficult due to the changes of sitting arrangement
	In this pandemic I missed learning an important topic to learn in school, so this pandemic affected my career
	Not too pleased with it, because I love practicing
	Pandemic era is the worst in my education journey
	Students get distracted easily
	The pandemic affects my classes and internship which makes me miss the opportunity to learn outside the classroom
	Online learning should be improved on.
	Virtual learning should be effective

Source: Respondents comments

Overall Perspective of Teaching Forest Sciences in the COVID-19 pandemic era

The lecturers were asked to describe their overall perspective on teaching forest sciences in the COVID-19 pandemic era. The result is presented in a word cloud (Figure 12), showing that half of them were positive and the other half were negative about their experience.

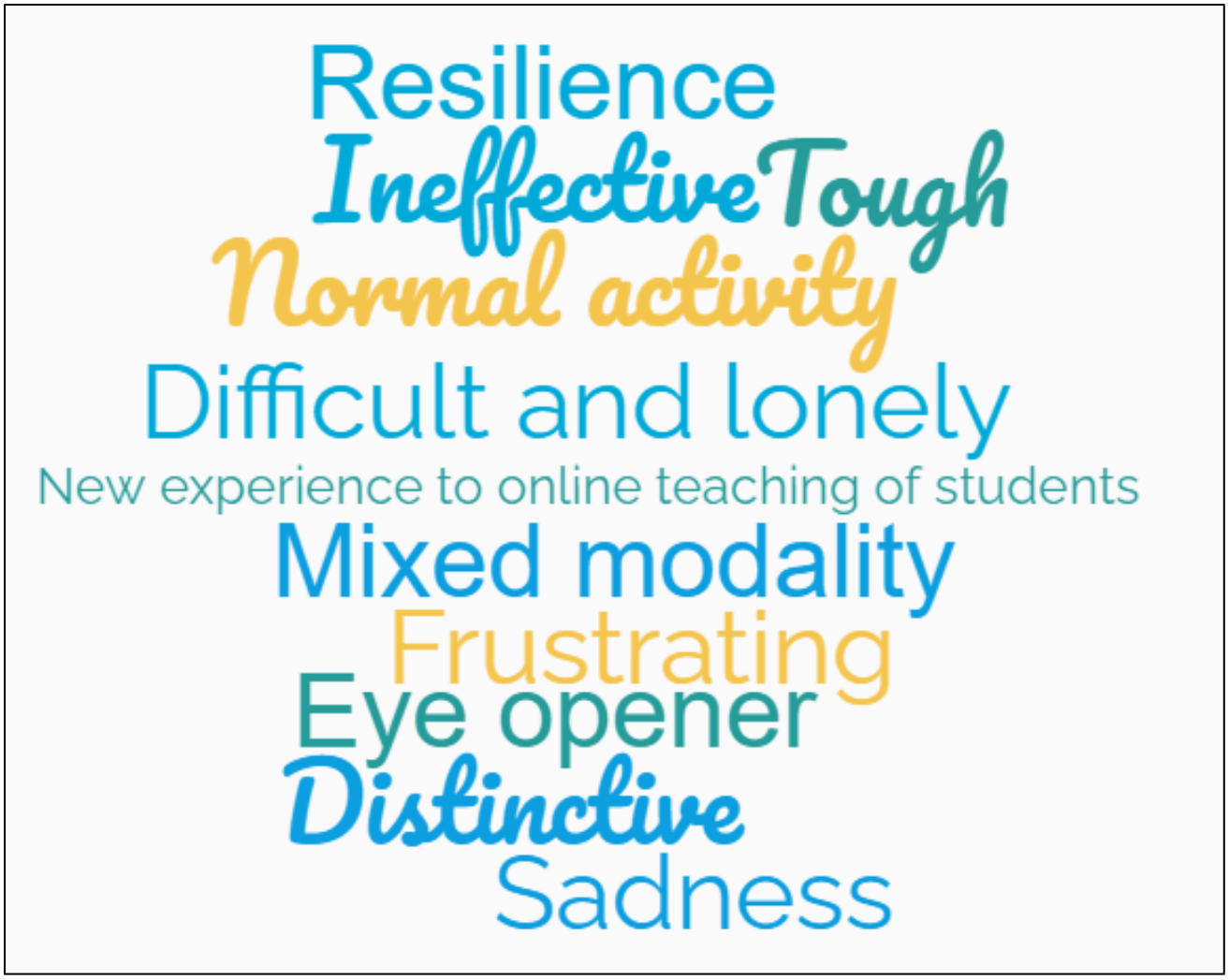

Figure 13: Word cloud of general lecturers' perspective on teaching forest sciences in the COVID-19 pandemic era
Source: Respondents Comment

4.6 Synthesis of the general thesis

The purpose of this section is to provide a snapshot of the entire results and a discussion based on the thesis objectives.

4.6.1 Objective 0: Demographic information of the respondents

The total number of responses received and analyzed for the study was 238, of which 23 are lecturers and 215 are students. Nigeria has the highest number of respondents learning and teaching forest science in the selected universities. Among students, 83.72% of the respondents were from African universities and this is a direct indication that there is a high number of forestry students in the continent and the need to provide more support such as improved curriculum and teaching, pedagogy

training of lecturers, and career counselling for students (Kung'u et al., 2021; Onatunji et al., 2021; Rekola et al., 2019).

Having an increase in female students and a younger population of students aged between 18 – 24 years will not automatically solve the problem of gender and ageing workforce in the forest sector, especially in Europe (Da Silva & Schweinle, 2022). The forestry sector should purposively create policies and actions that will help attract young people such as increased salaries and benefits, to improve diversity, inclusivity, and innovation in the sector. Mentorship has also acknowledged as an effective way to help some of these challenges of attraction to forestry programmes and workforce (Bal et al., 2020; FAO, 2020d; Grubbström & Powell, 2020; Onatunji et al., 2021; Owuor et al., 2021; Roos et al., 2021).

For more than two decades, the 1999 Bologna declaration has helped promote academic mobility and cooperation such as exchange of students among European countries and universities that are members of the European Higher Education Area. The success of such exchanges has been reported in forest education, as they promote the development of a labour force that is well aware of forestry practices beyond their country of study and help foster European mobility of labour (de Jong et al., 2021; Kanowski, 2020; Lewark, 2021; Owuor & Rodríguez-piñeros, 2021; Tavares & Borges, 2021). This kind of mobilities and the provision of scholarships will also help increase the international diversity of need to be promoted in , also with the support of the African Union (Gabay & Rekola, 2019; Onatunji, 2021).

None of the lecturers in either Africa and Europe is under 35 years of age. The younger the lecturer, the more adaptable they may be to teaching technologies. This study is limited in knowing the level of gender diversity among lecturers at the sampled universities (Colfer, 2021; Koch & Matviichuk, 2021; Macinnis-Ng & Zhao, 2022; Sanz-Hernández et al., 2022). We need to look at internationalization of higher education beyond only international student recruitment. All lecturers who responded to the survey are nationals of the respective countries where the university is located. Therefore, universities that offer forestry degrees should also diversify their recruitment of academic staff. It is difficult to compare data on years of teaching experience. However, a similar study of professors teaching Forest Operation courses in the United States of America found an average of 13 years teaching experience as in this study (Dodson & Blinn, 2022).

4.6.2 Objective 1: To understand how virtual or blended teachings were carried out by forest science teachers in the selected universities before and during the outbreak of COVID-19 pandemic

Many African and European lecturers have used virtual teaching method during the COVID-19 pandemic only. There was a spike in virtual teaching during the COVID-19 pandemic, according to students. The use of virtual teaching/learning could be encouraged in Africa through improved funding for purchase or enhancement of computer technologies, both software and hardware (Kachaka & Nkwinkwa, 2020; Kung'u et al., 2021); and through collaboration with universities and partners within and outside the continent (Evans et al., 2010; Längin et al., 2004).

All lecturers, both Africans and Europeans, stated that their university policies have allowed them to take a course, module, or entire programme online to varying extent and teaching methods that can be used during the COVID-19 pandemic. African universities should offer more flexibility on how forest education can be taught online. However, it has been highlighted that the objectives of forestry education cannot be fully realized without field experiences and personal interactions (Dodson & Blinn, 2022; Lewoń & Pirożnikow, 2020).

Zoom (https://zoom.us/) is the number one online videoconferencing platform used by the respondents, both students and lecturers (AU = 96.3% and EU = 70.7%). Other popular platforms used are Google Meet, Blackboard Collaborate, and YouTube (pre-recorded lectures). Video conferencing has been used to teach forest science during the pandemic (Dodson & Blinn, 2021, 2022; Lewoń & Pirożnikow, 2020; Ratnasingam et al., 2020) and even in forestry workforce online training (Macdonald et al., 2007). In the future development of international virtual courses or forest science, the Zoom platform should be recommended due to its current popularity and usage in both in Africa and Europe.

The provision and attendance of pedagogy training in the delivery of lectures online by universities due to the COVID-19 pandemic increased from 20.8% to 45.8% for African lecturers and from 18.2% to 31.8% for European lecturers. The proportions of those who had access to these training courses when available but did not attend them also increased despite the COVID-19 pandemic. This may have been influenced in part by the limited time available for the lecturers to transition teaching online and other job commitments. Universities are recommended to provide forestry lecturers with training on digital teaching technologies and provide incentives to attend them (Alatni et al., 2021; Ali, 2020; Ferede et al., 2022; Leiba & Gafni, 2021; Rekola, 2019; Sultanova et al., 2021).

Surprisingly, 81.15% of students want the online classes to be recorded while only 9.02% of the students feel comfortable their voice and video are recorded with the lectures. This phenomenon has been confirmed by other studies, showing a reluctance of students to turn on their videos in online classes. In fact, one group of authors called it as *"generation invisible"* (Bedenlier et al., 2021). Some of the reasons include personal privacy, how others might perceive them, the sharing of personal background, the quality of internet connection, and not concentrating in class (Castelli & Sarvary, 2021; Tice et al., 2021).

According to lecturers, there is a steady increase in the options available to students to attend lectures before and during the COVID-19 pandemic. There is a massive increase in online synchronous learning from 4.5% before the pandemic to 77.3% during the pandemic for EU students. For the AU students, there is more , as 59.1% stated that students can choose to attend lectures online or face-to-face in class during the COVID-19 pandemic. The difference in flexibility of options before and during the pandemic is more pronounced in Europe than in Africa. The results of lecturers (and students) on the options available for teaching or learning are not unique for forestry education alone as similar pattern has been reported in various reports, including the regional differences in the level of diversity of options (Alvarez & Corcuera, 2021; Gibbons, 2022; Makruf et al., 2022; Naicker et al., 2022; Younis & Elbanna, 2022).

For 58.33% of the AU lecturers, 45.45% of the EU lecturers stated 'Lecturers *can select the course modality, but were encouraged to choose remote / online options'* while 'Remote / online *options compulsory for all courses'.* The reasons are not far-fetched. Europe was more hot by the pandemic than Africa, with Italy being in the top 25 of cumulative COVID-19 deaths per 100,000 population (Zhou et al., 2022). Lockdown measures are more stringent in Europe (Sobral et al., 2021) and Africa universities were less prepared to transition to virtual teaching (Abosede et al., 2021).

In recording their online classes, most of the lecturers record during their online classes either as a requirement by their university (31.82%) or at the discretion of the lecturers (59.09%). The top two reasons why the lecturers record their classes are for students to have access to go back to watch them later (55.17%), and for students missing the original presentation (37.93%). The flexibility of using class recordings ultimately contributes to students' academic success (Al-Hashmi, 2021; Alatni et al., 2021; Cahyadi et al., 2021; Dodson & Blinn, 2022).

Most lecturers (65.22%) partially modified the assignments given to students during the pandemic. It is necessary for forestry lecturers to be dynamic in the kind and length of assignments that they give

their students (Dodson & Blinn, 2021, 2022). It is not all bad for lectures to be offered in a variety of mediums, as students now have more flexibility on how they choose to attend lectures (either online or in-presence), this was not previously available for most forestry science students before the pandemic (Awan et al., 2021; Ngafeeson, 2021; UNESCO, 2020). ese new technologies could strengthen virtual mobility in forest sciences (Tahvanainen, 2003) and be a baseline for preparing students to learn new technologies used in the forest sector (Reynolds et al., 2005).

4.6.3 Objective 2: To explore the challenges faced by students in learning and teachers in teaching of forest science during the COVID-19 pandemic in the selected universities

The top three rankings on a 5-point Likert scale on the general challenges faced during online learning during the COVID-19 pandemic by the students are missing the interactions they used to have with their colleagues and lecturers before and after lectures (Mean = 4.28), followed by missing going on field trips (Mean = 4.27), and missing laboratory work (Mean = 4.00). Previous studies also confirmed that interactions are really essential for student learning experience, employability, motivation, and success, among others (Filho et al., 2021; Fuchs & Karrila, 2022; Kinnula et al., 2021; Scott & Willison, 2021). Different studies have confirmed this need for social skills for forestry students around the world and found it to be deficient in most university curricula. Thus, the pandemic could further be compounding the problem (De'Arman & York, 2021; Mgaga & Scholes, 2019; Rekola et al., 2019; Sample et al., 2015). Universities should incorporate laboratory and field trips in their forest education curriculums (Kachaka & Nkwinkwa, 2020; Kung'u et al., 2021).

In regional contrast, African students ranks (4^{th}) not having free and fast Internet at home higher than their EU counterparts (11^{th}). The issue of underdevelopment of internet infrastructure in Africa has been highlighted by other studies and there is a need to urgently incorporate ICT into higher education in Africa (ADEA, 2020; Anifowoshe et al., 2020; Kachaka & Nkwinkwa, 2020; Kung'u et al., 2021).

Students also face other challenges such as financial burden of purchasing internet subscription, delayed graduation, difficulty in accessing class recordings, inability to request recommendation letters from professors, inability to really grasp difficult topics such as statistics, low level of concentration due to home chores, lack of motivation in pursuing my degree, lecturers' ability to answer only a few of the students' questions. In one of the students' words - 'Teaching *and learning facilities for me as a forestry student becomes limited, because to me, online classes are just formalities.'*

The lecturers were asked to rank the general challenges faced during online teaching in the COVID-19 pandemic. It is nice to see that as students miss interactions, so do lecturers miss the interactions

they used to have with students before and after lectures (mean = 3.87). The lecturers also had to stop field visits due to the pandemic (mean = 3.65); and their course load and work hours increased due to the pandemic (Mean = 3.39). No regional differences were observed among the ranking provided by the lecturers. These challenges have been confirmed by forest operations instructors in a US survey (Dodson & Blinn, 2022).

The top three challenges experienced and communicated to the universities by the students are studies/lab/fieldwork were delayed (22.79%), problems with Internet connection, i.e. availability, speed, reliability, etc. (16.28%), and they had trouble motivating themselves to attend online lectures, watch lectures videos, or complete an online assignment (10.7%). The students stated that they experienced some challenges but did not report to the universities, such as having difficulties in focus and time management (54.88%), trouble motivating themselves to attend online lectures, watch lectures videos, or complete an online assignment (47.44%), and experiencing difficulties with online learning because it does not match their learning style (45.58%).

In regional contrast (Table available in the Appendix), 91.67% of AU students do not experience contracting and recovering from the COVID-19 virus disease, while this number is 57.14% of the EU students. While more AU students (45.00%) experienced but were not communicated with their respective universities on problems with internet connection, i.e. availability, speed, reliability, etc., this number is only 17.14% for EU students. The proportion of EU students (25.71%) who experienced and reported to their respective universities contracting and recovering from the COVID-19 virus disease is higher than their AU counterparts (2.22%). Students are encouraged to report the challenges they face during their studies to the universities. Furthermore, students should be realistic about the support their lecturers and university can provide them in a difficult period such as the COVID-19 pandemic.

Many of the lecturers (47.83 - 73.91%) have not experienced the common challenges listed in the questionnaire. Not all challenges experienced are communicated to the universities, as 43.48% of the lecturers stated, experiencing delay in their research/lab/fieldwork; experiencing loneliness or isolation with the lockdown and restrictions; and having trouble motivating their students to attend lectures, watch lecture videos or complete an online assignment. Difficulties with focus and time management (21.74%); and experiencing difficulties organizing examinations online (13.04%) are challenges experienced and reported by the lecturers. It is recommended that forestry curriculum should be flexible to allow a variety of examination modes, and universities should train lecturers on how to

conduct effective virtual examinations (Ajagbe et al., 2021; Aristovnik et al., 2020; Awan et al., 2021; Dietrich et al., 2020; Jacob, 2020; Jacob et al., 2021; Makruf et al., 2022; Twesige et al., 2021).

Pedagogy dissatisfaction has been reported among lecturers (Sansom, 2020). It is quite unfortunate that most of the research conducted on virtual teaching has focused more on students and their satisfaction and fewer desire to understand challenges faced by lecturers (Aristovnik et al., 2020; Biyiri & Dissanayake, 2021; Fuchs & Karrila, 2022; Shyju et al., 2021; Sun et al., 2008; Zhang et al., 2021). Therefore, I recommend that further studies be carried out on the perception and experience of this important topic on virtual teaching in forest science (Cutri et al., 2020; Leiba & Gafni, 2021; Sample et al., 2015; Sansom, 2020).

4.6.4 Objective 3: To explore the perceived prospects of online teaching and learning of forest science post COVID-19 pandemic in the selected universities

According to the students, the top four ranking on some prospects of learning forest science online on a 5-point Likert scale are - the pandemic has helped the students to enhance their soft skills such as collaboration, working in a team, and use of ICT tools, etc. (mean = 3.93); the opportunity to combine studies and work (Mean = 3.70); and the opportunity to participate in more extracurricular activities, e.g., voluntary activities (Mean = 3.65); and the pandemic has opened the opportunity to introduce new and emerging topics such as Greencare, forests and human health, etc. to the students (Mean = 3.65).

The use of virtual teaching has helped to strengthen the student's soft skills and gain experience through volunteering, therefore contributing to future employability prospects for forestry graduates and to succeed at their jobs (Cheang & Yamashita, 2020; EFI et al., 2022; Kelly & Brown, 2019; Rekola et al., 2019; Scott & Willison, 2021; T. Wilson, n.d.). The COVID-19 pandemic has also helped to popularize new topics such as Greencare, forest, and human health, leading to more diverse career opportunities for forestry graduates especially in the green jobs and bioeconomy sectors (Da Silva & Schweinle, 2022; Doimo et al., 2021; EFI et al., 2022; FAO, 2020a; FAO & UNECE, 2018; Larasatie et al., 2020; Masiero et al., 2020).

This study confirms that forestry students are not ready for virtual reality (VR) as a means of learning now. Universities should consider designing VR-based learning systems for forest science with easy, useful and enjoyable functions to encourage students to use (Wang et al., 2022). Some other prospects of virtual learning in the words of the students (only Africans responded) are – *'If online studies are*

to be adopted, then there's is need to reduce tuition"; *"Many topics were covered in the shortest time possible"*; *"Opportunity to have fun with family"*; *"Pandemic has exposed students to the real work outside the university walls";* and *"Putting into consideration the way of learning in my university where we have more theory than practical, virtual learning is still okay because there is no develop equipment to learn the real practical of field work'.*

Students have been reported to prefer a flexible student-centered learning approach over the use of recorded video or Zoom meetings to learn wood science in Malaysia. The ease of using online learning platform reduce over more practical courses (Ratnasingam et al., 2020). Additionally, viewing a pre-recorded informational video on forestry positively affects the perception of over 1,000 undergraduate students in 18 United States of America universities on urban forestry as a career path (O'Herrin et al., 2018). In my own personal view, guest lecturers could be future employers and collaborators if students maximize it. For example, I interned in a research institute where we have guest lecturers in my first year of Masters.

In addition, this study shows that the use of online examination methods is still very minimal in forest science programmes. It has been reported that the use of online examinations is not very efficient and there is a need for more improvement in such technologies coupled with better ICT infrastructure to make them scalable on a wider university scale and a need for training lecturers on online assessment (Ajagbe et al., 2021; Makruf et al., 2022; Montenegro-rueda et al., 2021; Twesige et al., 2021; Weerawardane, 2021).

According to lecturers, the top three ranking in the prospects of teaching forest science online based on ranking on a 5-point scale are experimenting with new tools and teaching approaches (Mean = 4.14); the use of virtual teaching tools has forced/helped teachers/professors to innovate, to learn new techniques and software and skills as professors (Mean = 4.00); and participating in academic conferences is now easier and cheaper through online platforms (Mean = 3.77).

International research and project collaboration is the basis of good forestry science and research, as forests are being more interconnected, and several international policies affect forests on a national and local basis. Therefore, it is imperative that students and lecturers connect with others to share experiences and how our forests can be better managed (Rodríguez-Piñeros et al., 2020; Zeng et al., 2020). It is not surprising that lecturers at European universities are already researching the intersection of forests and human health as it is already becoming a popular field with heightened awareness during COVID-19 pandemic, especially on the use of green places during the lockdown (Bamwesigye et al.,

2021; FAO, 2020a; FAO & UNECE, 2018; Frakes et al., 2022; Jarský et al., 2022; Talal & Gruntman, 2022; Weinbrenner et al., 2021). For example, about 232 Greencare initiatives have been reported in Italy alone (Doimo et al., 2021), thus, the importance of forests to contribute to green recovery is being increasingly recognized (FAO, 2022b).

We need beyond just transition but transformation and diversification of academic assessment methods (O'Neill & Padden, 2022; Weerawardane, 2021). Regional differences are expected based on their level of development and institutional policies.

4.6.5 Objective 4: To explore the perspectives of teachers and students on the lasting impacts that teaching and learning forest science in COVID-19 pandemic area could have on future careers of students

Based on the results. Now is the right time for universities to foster collaboration that could lead to exchange of students both virtually and face-to-face intercontinental wise as they are in high demand by the respondents. The COVID-19 pandemic will help create more job possibilities/opportunities for forestry graduates especially in areas not previously and fully explored such as Greencare, forest and human health, forest and zoonotic disease, the one health approach, sustainable bioeconomy, etc. (Adhikari & Ozarska, 2018; Doimo et al., 2021; FAO, 2020a; Macht et al., 2022; UNEP, 2020).

It is not surprising that European respondents feel that the quality of forest education provided during the pandemic was compromised as there were usually more field trips than are currently available. For example, the only field trip that was planned for my second year at the University of Padova, Italy was cancelled as a substantial proportion of students and a lecturer tested COVID-19 positive few days before the trip. In my first year in University of Lleida, Spain, the lecturers are required to put social distancing in place in planning field trip such as taking only two students per car or fewer persons in a bus. Social interactions among students and lecturers were reduced during the pandemic in Europe, too, thus the projection for weaker social skills.

As a follow-up and open-ended question, respondents were also asked to optionally provide other direct and short-term outcomes of the COVID-19 pandemic on forest education. Most of the (8 of 11) comments revolve around compromised learning and fewer field trips. Limited internship period, stress-relieving learning, and mixed feelings. The overall perspective of learning and teaching forest sciences in the COVID-19 pandemic era is more negative for students, while it is half positive and half negative for lecturers.

Chapter 5: Conclusions and final recommendations

5.1 Conclusions

The following conclusions are drawn on the results obtained from this study.

This study reechoed the fact that there are high number of forestry students in Nigeria as a country and Africa as a continent. Among the student respondents, proportion of women is increasing, and most of the student population are youth, aged 18 to 24 years. Therefore, helping to provide the needed workforce for the forestry sector. The level of student internationalization is high in European universities and non-existent in the Africa counterpart. There is also a need for integration of diversity of professionals from other nationals in teaching of forestry as all lecturers who responded to the survey are nationals of the respective countries where the university is located.

Many African and European lecturers have used virtual teaching method during the COVID-19 pandemic, and their university policies have allowed them to take a course or module or entire programme online with a varying extent and teaching methods. The difference in flexibility of options before and during the pandemic is more pronounced in Europe than in Africa. The top on-line videoconferencing platforms used by the respondents, both students and lecturers are Zoom, Google meet, Blackboard Collaborate, and YouTube (pre-recorded lectures). The provision and attendance of pedagogy training on the delivery of lectures online by universities due to the COVID-19 pandemic also increased. Only a small proportion of students feel comfortable with their voice and face in the lectures. However, a large proportion want the classes to be recorded and have used recorded videos for their learning.

Missing the interactions students used to have with their colleagues and lecturers before and after lectures, missing going on field trips, and missing laboratory work are the three general challenges faced during online learning during the COVID-19 pandemic. These challenges are also faced by the lecturers too, only that their course load and work hours were also increased due to the COVID-19 pandemic. Not every challenge experienced by lecturers and students is reported to the universities. They are but not limited to, experiencing delay in their research/lab/fieldwork; experiencing loneliness or isolation with the lockdown and restrictions; and having trouble motivating their students to attend lectures, watch lecture videos, or complete an online assignment for the lecturers. For students, these include having difficulties with being focus and time management; motivating oneself to attend online lectures, watch lectures videos, or complete an online assignment; and experiencing difficulties with online learning because it does not match ones learning style.

There are some prospects of learning and teaching forest science online. For students, the pandemic has helped to enhance their soft skills such as collaboration, working in a team, and use of ICT tools, etc.; the opportunity to combine studies and work; and the opportunity to be engaged in more extra-curricular activities e.g., voluntary activities; and the pandemic has opened the opportunity to introduce new and emerging topics such as Greencare, forest, and human health, etc. to students. The least-ranked prospects in the perspective of the students are the use of Virtual reality (VR) as a learning tool. The prospects reported by the lecturers are experimenting with new tools and teaching approaches; the use of virtual teaching tools has forced/helped teachers/professors to innovate, to learn new techniques and software and skills as professors; and participating in academic conferences is now easier and cheaper through online platforms.

It is not surprising that lecturers at European universities are already researching the intersection of forests and human health as it is already becoming a popular field with heightened awareness during COVID-19 pandemic, especially on the use of green places during the lockdown. The COVID-19 pandemic will possibly help create more job possibilities/opportunities for forest graduates especially in areas not previously and fully explored such as Greencare, forest and human health, forest and zoonotic disease, the one health approach, sustainable bioeconomy, etc.

The overall perspective of learning and teaching forest sciences in the COVID-19 pandemic era is more negative for students, while it is half positive and half negative for lecturers. It is not surprising that European respondents feel that the quality of forest education provided during the pandemic was compromised as there were usually more field trips than are currently available.

5.2 Recommendations

I write some suggested actions that can be carried out based on the results and conclusion of this study. The recommendations are in three part: part one as a general one; part two for African audience; and part three for the European audience.

General recommendations

- The forestry sector should purposively create policies and actions that will help attract young people such as mentorship, increased salaries, and benefits to improve diversity, inclusion, and innovation in the sector.

- The internationalization of higher education should go beyond international student recruitment only. Therefore, universities that offer forestry degrees should also diversify their recruitment of academic staff.
- In the future development of international virtual courses for forest science, the Zoom platform should be recommended due to its current popularity and usage in both Africa and Europe. These new technologies could strengthen virtual mobility in forest sciences and serve as a baseline to make students learn new technologies used in the forestry sector.
- Universities should provide forestry lecturers with training on digital teaching technologies and provide incentives to attend them. Forestry lecturers to be dynamic in the kind and length of assignments they give their students.
- Universities should ensure equity in access and use of online teaching platforms by creating an enabling environment for all the students regardless of their gender, family income, and access to the internet and computer.
- University lecturers are under intense pressure to learn, develop themselves, and always put the students first. Universities should endeavour to increase the number of academic staff, reduce administrative duties to reduce workload, and promote work-life balance among lecturers.
- Students are encouraged to report the challenges they face during their studies to the universities. Furthermore, students have to be realistic about the support their lecturers and university can provide them in a difficult period such as the COVID-19 pandemic.
- Forestry curricula should be flexible to allow a variety of examination modes, and universities should train lecturers on how to conduct effective virtual examinations.
- Universities should consider designing VR-based learning systems for forest science with easy, useful, and pleasant functions to encourage students to use them.
- Universities should explore creating blended learning forestry degree programme that will cost less tuition fee. This could be a means to attract more people to study forestry and encourage professional development.
- It is imperative that students and lecturers connect with others to share experiences and how our forests can be better managed. International research and project collaboration is the basis of good forestry science and research, as forests are being more interconnected, and several international policies affect forests on a national and local basis.
- Now is the right time for universities to foster collaboration that could lead to exchange of students both virtually and face-to-face intercontinental wise as they are in high demand by the respondents.

Africa

- The high number of forestry students in the Africa continent justifies the need to provide more support such as improved curriculum and teaching, pedagogy training of lecturers, and career counselling for students.
- Academic mobilities and the provision of scholarship will also help increase the international diversity of need to be promoted in Africa with the support of the African Union.
- African universities should offer more flexibility on how forest education can be taught online. The use of virtual teaching/learning could be encouraged in Africa through better funding for purchase or enhancement of computer technologies, both software and hardware.

Europe

- Social interactions among students and lecturers were reduced during the pandemic in Europe, too, thus the projection for weaker social skills. Thus, European universities need to be more intentional in incorporating laboratory experience, field trips, and development of social skills in their forest education curriculums despite the COVID-19 pandemic.

5.3 Suggested further research

I would like to suggest the following topics to be further explored.

- How attractive are academic and research jobs in the forestry sector to young people? We should examine the chances that the forestry students of today will become university lecturers of the future. This is especially important for Europe as the lecturers are older than in the Africa case.
- I recommend that further studies be carried out on faculty perception and experience on this important topic of virtual teaching in forest science.
- Future studies on the impact of virtual teaching on the employability and employment opportunities of forestry students.
- Further studies on the impact of COVID-19 pandemic on teaching and learning forest science which includes interviews of students, lecturers, and academic staff. This should be complemented with direct observation of teaching and assessment tools.
- Research the possible impact of COVID-19 on admission enrolment, gender and ethnic diversity, attractiveness of the programme, graduation of forestry students among other using official university statistics.

References

Abosede, C., Oresajo, O., & Akintola, O. (2021). COVID-19 and Higher Education in Nigeria: The Present and the Future. *Interdisciplinary Journal of Education*, *4*(2), 100–113. https://doi.org/10.53449/ije.v4i2.59

ADEA. (2020). *Impact on Education in African Countries*.

Adeyanju, S., Adesuyi, O., Offiah, C., Fasalejo, O., & Ogunlade, B. (2022). Where are the foresters? The influx of forestry graduates to non-forestry jobs in Nigeria. *XV World Forestry Congress: Building a Green, Healthy and Resilient Future with Forests*, 1–11. https://www.researchgate.net/publication/360194133_Where_are_the_foresters_The_influx_of_forestry_graduates_to_non-forestry_jobs_in_Nigeria

Adeyanju, S., Ajilore, O. H., Ogunlalu, O., Onatunji, A., & Mogaji, E. (2022). Innovating in the face of the pandemic: Case studies from Nigerian Universities. In J. S. McKeown, K. Bista, & R. Y. Chan (Eds.), *Global Higher Education During COVID-19: Policy, Society, and Technology* (pp. 104–120). STAR Scholars In collaboration with Open Journals in Education and Journal of International Students. https://www.researchgate.net/publication/343774545_Innovating_in_the_face_of_the_Coronavirus_Covid-19_pandemic_Case_studies_from_Nigerian_Universities

Adhikari, S., & Ozarska, B. (2018). Minimizing environmental impacts of timber products through the production process "From Sawmill to Final Products." *Environmental Systems Research*, *7*(1), 15. https://doi.org/10.1186/s40068-018-0109-x

Ajagbe, S. A., Adesina, A. O., Ilupeju, O. A., Thanh, L. T., & Thanh, D. N. H. (2021). Challenges and Perceptions in the Use of ICT in Student Assessments During the Covid-19 Pandemic. *2021 8th International Conference on Information Technology, Computer and Electrical Engineering (ICITACEE)*, *September*, 89–94. https://doi.org/10.1109/ICITACEE53184.2021.9617480

Akande, A. J. (2008). Challenges to Forestry Education: A Perspective from Nigeria. In A. B. Temu, S. A. O. Chamshama, J. Kung'u, J. Kaboggoza, B. Chikamai, & A. Kiwia (Eds.), *New Perspectives in Forestry Education. Peer reviewed papers presented at the First Global Workshop on Forestry Education, September 2007* (pp. 65–82). ICRAF,. http://library1.nida.ac.th/termpaper6/sd/2554/19755.pdf

Al-Ansi, A. M. (2021). Students anxiety and recruitment during Covid-19 pandemic: role of university, specialization and employment expectation. *Perspectives of Science and Education*, *49*(1), 403–413. https://doi.org/10.32744/pse.2021.1.27

Al-Hashmi, S. (2021). A Study on the Impact of the Sudden Change to Online Education on the Motivation of Higher Education Students. *Higher Education Studies*, *11*(3), 78–90. https://doi.org/10.5539/hes.v11n3p78

Al-Jubory, D. H., & Al-Shamery, E. S. (2021). An Analysis of the Impact of Mobility on the Spread of the Covid-19 Pandemic. *2021 1st Babylon International Conference on Information Technology and Science (BICITS)*, *April*, 127–132. https://doi.org/10.1109/BICITS51482.2021.9509902

Alatni, B. S., Abubakar, I. R., & Iqbal, S. A. (2021). COVID-19 and Rapid Course Adaptations in Saudi Arabia: An Experiential Learning and Recommendations for Online Education. *Frontiers in Psychology*, *12*, 1–14. https://doi.org/10.3389/fpsyg.2021.643203

Ali, W. (2020). Online and Remote Learning in Higher Education Institutes: A Necessity in light of COVID-19 Pandemic. *Higher Education Studies*, *10*(3), 16–25. https://doi.org/10.5539/hes.v10n3p16

Alvarez, A. V. J., & Corcuera, L. C. (2021). The Webinar Experiences of Higher Education Instructors in the Time of Emergency Remote Education. *International Journal of Scholars in Education*, *January*, 134–145. https://doi.org/10.52134/ueader.983093

Ameyaw, J., Wals, A. E. J. E. J. J., Arts, B., & Turnhout, E. (2019). Does a transdisciplinary approach to forestry education meet students' career aspirations? Lessons from a curriculum innovation in Ghana. *International Forestry Review*, *19*(4), 397–412. https://doi.org/10.1505/1465548822272365

Anifowoshe, O., Aborode, A. T., Ayodele, T. I., Iretiayo, A. R., & David, O. O. (2020). Impact of COVID-19 on Education in Sub-Saharan Africa. *Preprints*, *2890*(October), 1–29. https://doi.org/10.20944/preprints202007.0027.v1

Arevalo, J., Pitkänen, S., Gritten, D., Tahvanainen, L., Pitäknen, S., Gritten, D., & Tahvanainen, L. (2010). Market-relevant competencies for professional foresters in European graduate education. *International Forestry Review*, *12*(3), 200–208. https://doi.org/10.1505/ifor.12.3.200

Arevalo, J., Pitkänen, S., & Kirongo, B. (2014). Developing forestry curricula: Experiences from a kenyan-finnish project. *International Forestry Review*, *16*(1), 78–86. https://doi.org/10.1505/146554814811031242

Aristovnik, A., Keržič, D., Ravšelj, D., Tomaževič, N., & Umek, L. (2020). Impacts of the COVID-19 Pandemic on Life of Higher Education Students: A Global Perspective. *Sustainability*, *12*(20), 8438. https://doi.org/10.3390/su12208438

Awan, R. K., Afshan, G., & Memon, A. B. (2021). Adoption of E-Learning at Higher Education Institutions: A Systematic Literature Review. *Multidisciplinary Journal for Education, Social and Technological Sciences*, *8*(2), 74. https://doi.org/10.4995/muse.2021.15813

Babalola, F. D., & Onatunji, A. B. (2018). Assessment of Factors Responsible for Diploma Students' Decision to Study Forestry. In A. O. Akinwole, V. A. J. Adekunle, & O. Y. Ogunsanwo (Eds.), *Emerging Issues in Sustainable Forest Management: Experiences and Lessons for Nigeria* (pp. 62–68). Forestry Association of Nigeria.

Bal, T. L., Rouleau, M. D., Sharik, T. L., & Wellstead, A. M. (2020). Enrollment decision-making by students in forestry and related natural resource degree programmes globally. *International Forestry Review*, *22*(3), 287–305. https://doi.org/10.1505/146554820830405627

Bamwesigye, D., Fialová, J., Kupec, P., Łukaszkiewicz, J., & Fortuna-Antoszkiewicz, B. (2021). Forest recreational services in the face of COVID-19 pandemic stress. *Land*, *10*(12). https://doi.org/10.3390/land10121347

Baublyte, G., Korhonen, J., D'Amato, D., & Toppinen, A. (2019). "Being one of the boys": perspectives from female forest industry leaders on gender diversity and the future of Nordic forest-based bioeconomy. *Scandinavian Journal of Forest Research*, *34*(6), 521–528. https://doi.org/10.1080/02827581.2019.1598484

Bedenlier, S., Wunder, I., Gläser-Zikuda, M., Kammerl, R., Kopp, B., Ziegler, A., & Händel, M. (2021). "Generation invisible?. Higher Education Students' (Non)Use of Webcams in Synchronous Online Learning. *International Journal of Educational Research Open*, *2*(October), 100068. https://doi.org/10.1016/j.ijedro.2021.100068

Beytekin, O. F. (2021). Transformation of Higher Education into New Normal. *Higher Education Studies*, *11*(3), 125. https://doi.org/10.5539/hes.v11n3p125

Bin, Y., Joseph, E. V., & Oguche, I. A. (2021). New Features and Trends of Higher Education during the Epidemic Period. *Journal of Educational Theory and Management*, *5*(2), 41. https://doi.org/10.26549/jetm.v5i2.7523

Biyiri, E. W., & Dissanayake, D. M. M. I. (2021). A Study on Satisfaction towards the Online Learning among the Tourism & Hospitality Management Students during the Covid 19 Pandemic. *Journal of Management and Tourism Research*, *4*(1), 37–57.

Bond, M., Bedenlier, S., Marín, V. I., & Händel, M. (2021). Emergency remote teaching in higher education: mapping the first global online semester. *International Journal of Educational Technology in Higher Education*, *18*(50), 1–24. https://doi.org/10.1186/s41239-021-00282-x

Bryson, J. R., & Andres, L. (2020). Covid-19 and rapid adoption and improvisation of online teaching: curating resources for extensive versus intensive online learning experiences. *Journal of Geography in Higher Education*, *44*(4), 608–623. https://doi.org/10.1080/03098265.2020.1807478

Bullard, S. H., Stephens Williams, P., Coble, T., Coble, D. W., Darville, R., Rogers, L., Williams, P. S., Coble, T., Coble, D. W., Darville, R., & Rogers, L. (2014). Producing "society-ready" foresters: A research-based process to revise the bachelor of science in forestry curriculum at Stephen F. Austin State University. *Journal of Forestry*, *112*(4), 354–360. https://doi.org/10.5849/jof.13-098

Burmann, L. L., Kelly, M. C., Schelly, C., & Bal, T. L. (2022). Formative Interests and Pathways to Natural Resources Careers among Historically Underrepresented People. *Society & Natural Resources*, *0*(0), 1–21. https://doi.org/10.1080/08941920.2022.2028046

Buyinza, M. (2004). Forestry Education in a Changing Landscape: Emerging Lessons from Uganda. *Makerere Journal of Higher Education*.

Buyinza, M., & Vedeld, P. (2009). Restore, reform or transform forestry education in Uganda? *Makerere Journal of Higher Education*, *2*(1), 112–120. https://doi.org/10.4314/majohe.v2i1.46400

Cahyadi, A., Hendryadi, Widyastuti, S., Mufidah, V. N., & Achmadi. (2021). Emergency remote teaching evaluation of the higher education in Indonesia. *Heliyon*, *7*(8), 1–9. https://doi.org/10.1016/j.heliyon.2021.e07788

Cardellini, G., Natalini, F., Bruschini, S., & Marchetti, M. (2012). Forestry education in Italy and the Bologna Process : how it affects students and their perception of University. *IUFRO Conference "Forests for People-International Experiences and the Vital Role of Forests for the Future" Alpbach*, *May*.

Castelli, F. R., & Sarvary, M. A. (2021). Why students do not turn on their video cameras during online classes and an equitable and inclusive plan to encourage them to do so. *Ecology and Evolution*, *11*(8), 3565–3576. https://doi.org/10.1002/ece3.7123

Chattaraj, D., & Vijayaraghavan, A. P. (2021). The mobility paradigm in higher education: a phenomenological study on the shift in learning space. *Smart Learning Environments*, *8*(15), 1–24. https://doi.org/10.1186/s40561-021-00162-x

Cheang, M., & Yamashita, G. L. (2020). Employers' Expectations of University Graduates as They Transition into the Workplace. *European Journal of Social Science Education and Research*,

7(3), 27–36. https://doi.org/10.26417/423zyk21l

Chen, T., & Lucock, M. (2022). The mental health of university students during the COVID-19 pandemic: An online survey in the UK. *PLoS ONE*, *17*(1), 1–17. https://doi.org/10.1371/journal.pone.0262562

Cheng, J. (2021). Evaluation of physical education teaching based on web embedded system and virtual reality. *Microprocessors and Microsystems*, *83*, 103980. https://doi.org/10.1016/j.micpro.2021.103980

Chirwa, P. W., Kamwi, J. M., Kabia, G., Makhubele, L., Sagona, W., Matakala, N., & Gondo, P. (2021). The Impacts of COVID-19 on the Sustainable Management of the Forestry Sector in Southern Africa. *International Forestry Review*, *23*(3), 298–308. https://doi.org/10.1505/146554821833992785

Chukwu, O., Ezenwenyi, J. U., & Mebude, K. O. (2018). Spatial Distribution of Nigerian Universities offering Forestry Education using Geographic Information System. *World News of Natural Sciences*, *20*(August), 226–237. www.worldnewsnaturalsciences.com

Cocoradă, E., Curtu, A. L., Năstasă, L. E., & Vorovencii, I. (2021). Dropout intention, motivation and socio-demographics of forestry students in Romania. *Forests*, *12*(5), 1–16. https://doi.org/10.3390/f12050618

Colfer, C. J. P. (2021). *Masculinities in forests: Representations of Diversity*. Routledge.

Consoli, D., Marin, G., Marzucchi, A., & Vona, F. (2016). Do green jobs differ from non-green jobs in terms of skills and human capital? *Research Policy*, *45*(5), 1046–1060. https://doi.org/10.1016/J.RESPOL.2016.02.007

Cutri, R. M., Mena, J., & Whiting, E. F. (2020). Faculty readiness for online crisis teaching: transitioning to online teaching during the COVID-19 pandemic. *European Journal of Teacher Education*, *43*(4), 523–541. https://doi.org/10.1080/02619768.2020.1815702

Da Silva, E. J., & Schweinle, J. (2022). *Green Jobs in the Pan-European Forest Sector*. http://www.thuenen.de

De'Arman, K. J., & York, R. F. (2021). "Society-Ready" and "Fire-Ready" Forestry Education in the United States: Interdisciplinary Discussion in Forestry Course Textbooks. *Journal of Forestry*, *119*(3), 236–250. https://doi.org/10.1093/jofore/fvaa062

de Jong, W., Huang, K., Zhuo, Y., Kleine, M., Wang, G., Liu, W., & Xu, G. (2021). A Comparison of Forestry Continuing Education Academic Degree Programs. *Forests*, *12*(824), 1–17.

https://doi.org/10.3390/f12070824

Dennis, M. J. (2021). Did COVID-19 make any positive contributions to higher education? *Dean and Provost*, *23*(2), 6–7. https://doi.org/10.1002/dap.30937

Dietrich, N., Kentheswaran, K., Ahmadi, A., Teychene, J., Bessiere, Y., Alfenore, S., Laborie, S., Bastoul, D., Loubiere, K., Guigui, C., Sperandio, M., Barna, L., Paul, E., Cabassud, C., Line, A., & Hebrard, G. (2020). Attempts, successes, and failures of distance learning in the time of covid-19. *Journal of Chemical Education*, *97*(9), 2448–2457. https://doi.org/10.1021/acs.jchemed.0c00717

Dodson, E. M., & Blinn, C. R. (2021). Forest operations instructor and student perspectives on rapid transition from face-to-face to online learning in the US. *International Journal of Forest Engineering*, *33*(1), 2–11. https://doi.org/10.1080/14942119.2021.1907109

Dodson, E. M., & Blinn, C. R. (2022). How Will COVID-19 Change Forestry Education? A Study of US Forest Operations Instructors. *Journal of Forestry*, *120*(2), 145–155. https://doi.org/10.1093/jofore/fvab050

Doimo, I., Masiero, M., & Gatto, P. (2021). Disentangling the Diversity of Forest Care Initiatives: A Novel Research Framework Applied to the Italian Context. *Sustainability*, *13*(2), 492. https://doi.org/10.3390/su13020492

EdTech Hub, & eLearning Africa. (2020). *The Effect of Covid-19 on Education in Africa and its Implications for the Use of Technology: A Survey of the Experience and Opinions of Educators and Technology Specialists Executive Summary 3 A Network of Experts: The eLearning Africa and EdTech Hub Sur*. https://doi.org/10.5281/zenodo.4018774

EFI, IFSA, & IUFRO. (2022). *What do universities offering forest-related programmes need to know about forest-related education and employment?* (p. 3). https://ifsa.net/wp-content/uploads/2022/04/Factsheets-Universities.pdf

Emeto, T. I., Alele, F. O., & Ilesanmi, O. S. (2021). Evaluation of the effect of border closure on COVID-19 incidence rates across nine African countries: An interrupted time series study. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, *115*(10), 1174–1183. https://doi.org/10.1093/trstmh/trab033

Erhan, Ç., & Gümüş, Ş. (2020). Opportunities and Risks in Higher Education in the Postpandemic Period. In *Reflections on the Pandemic in the Future of the World* (Issue October, pp. 179–193). Turkish Academy of Sciences. https://doi.org/10.53478/TUBA.2020.033

European University Association. (2020). European higher education in the Covid-19 crisis. In

International Association of Universities. https://eua.eu/downloads/publications/briefing_european higher education in the covid-19 crisis.pdf

Evans, P. D., Macdonald, I., Rypstra, T., Mortimer, J., Wessels, C. B., Muller, R., Muller, B., & Louw, J. (2010). South Africa's wood processing industry education strategy: north south partnership to develop a globally competitive workforce for the 21st century. *International Wood Products Journal*, *1*(1), 48–56. https://doi.org/10.1179/2042645310Y.0000000001

FAO. (2020a). Forests for human health and well-being – Strengthening the forest–health–nutrition nexus. In *Forestry Working Paper* (No. 18; Vol. 17). FAO. https://doi.org/10.4060/cb1468en

FAO. (2020b). *Global Forest Resources Assesment 2020: Italy country report*. FAO. https://www.reteclima.it/wp-content/uploads/FRA2020-Italy.pdf

FAO. (2020c). *Global Forest Resources Assesment 2020: Uganda country report*. FAO. https://www.fao.org/3/cb0084en/cb0084en.pdf

FAO. (2020d). *Global Forest Resources Assessment 2020: Main Report*. FAO. https://doi.org/10.4060/ca9825en

FAO. (2022a, February 17). *Broadening forestry education to tackle the climate crisis: New generations of students help adapt local knowledge and practices to a changing world*. FAO. https://www.fao.org/fao-stories/article/en/c/1471541

FAO. (2022b). *The State of the World's Forests 2022: Forest pathways for green recovery and building inclusive, resilient and sustainable economies.* (The State of the World). FAO. https://doi.org/10.4060/cb9360en

FAO, & CPF. (2022). *Status of, and trends in, the global core set of forest-related indicators*. FAO. https://doi.org/10.4060/cb9963en

FAO, & UNECE. (2018). Green jobs in the forest sector. In *Geneva timber and forest discussion paper* (No. 71). Food and Agriculture Organization of the United Nations and the United Nations Economic Commission for Europe.

Ferede, B., Elen, J., Van Petegem, W., Hunde, A. B., & Goeman, K. (2022). Determinants of instructors' educational ICT use in Ethiopian higher education. *Education and Information Technologies*, *27*(1), 917–936. https://doi.org/10.1007/s10639-021-10606-z

Filho, W. L., Price, E., Wall, T., Shiel, C., Azeiteiro, U. M., Mifsud, M., Brandli, L., Farinha, C. S., Caeiro, S., Salvia, A. L., Vasconcelos, C. R., de Sousa, L. O., Pace, P., Doni, F., Veiga Avila, L.,

Fritzen, B., & LeVasseur, T. J. (2021). COVID-19: the impact of a global crisis on sustainable development teaching. *Environment, Development and Sustainability*, *23*(8), 11257–11278. https://doi.org/10.1007/s10668-020-01107-z

Fouqueray, T., & Frascaria-Lacoste, N. (2020). Social sciences have so much more to bring to climate studies in forest research: a French case study. *Annals of Forest Science*, *77*(81), 1–12. https://doi.org/10.1007/s13595-020-00989-3

Frakes, A., Joshi, O., & Poudyal, N. C. (2022). Understanding regional economic impacts of recreation spending at a public lake: A case study in rural Oklahoma, USA. *Journal of Outdoor Recreation and Tourism*, *39*(100504), 6. https://doi.org/10.1016/j.jort.2022.100504

Fuchs, K., & Karrila, S. (2022). Satisfaction With Remote Teaching in Thai Higher Education. *Obrazovanie i Nauka*, *24*(2), 206–224. https://doi.org/10.17853/1994-5639-2022-2-206-224

Gabay, M., & Rekola, M. (2019). *Forests, peaceful and inclusive societies, reduced inequality, education, and inclusive institutions at all levels United Nations Forum on Forests* (Background Study Prepared for the Fourteenth Session of the United Nations Forum on Forests, Issue c). https://www.un.org/esa/forests/wp-content/uploads/2019/03/UNFF14-BkgdStudy-SDG4-10-16-March2019.pdf

Gibbons, C. (2022). Surviving a pandemic - Understanding the role of student stress, personality and coping on course satisfaction and anxiety during lockdown. *Innovations in Education and Teaching International*, 1–13. https://doi.org/10.1080/14703297.2022.2064326

Gibbs, P. (2020). What Might the Pandemic Have Done to and for Higher Education? *Enhancing the Human Experience of Learning with Technology: New Challenges for Research into Digital, Open, Distance & Networked Education*, *1*, 417–421. https://doi.org/10.38069/edenconf-2020-rw-0046

Grubbström, A., & Powell, S. (2020). Persistent norms and the #MeToo effect in Swedish forestry education. *Scandinavian Journal of Forest Research*, *35*(5–6), 308–318. https://doi.org/10.1080/02827581.2020.1791243

Hallal, K., HajjHussein, H., & Tlais, S. (2020). A Quick Shift from Classroom to Google Classroom: SWOT Analysis. *Journal of Chemical Education*, *97*(9), 2806–2809. https://doi.org/10.1021/acs.jchemed.0c00624

Hassan, Z., Sa'id, A. S., & Mohammed, H. A. (2021). Is Distance E-Learning Option Acceptable by Nigerians Amidst Covid-19 Pandemic? *African Journal of Education and Practice*, *7*(1), 11–25. https://doi.org/10.47604/ajep.1193

Havenga, S. (2019). *Canadian forestry professionals ' perceptions of forest management and climate change* [Lakehead University]. https://knowledgecommons.lakeheadu.ca/bitstream/handle/2453/4562/HavengaS2019b-1b.pdf?sequence=1&isAllowed=y

Hendrie, J. (2021). *How the Scottish School of Forestry has adapted in the face of the COVID-19 pandemic*. Forestry Journal. https://www.forestryjournal.co.uk/features/19097961.leading-challenging-times/

Hrbek, Š., Samuel, J., Karataş, B., Klapper, J., Wiking, C., Baluee, A., Guzman, S., Motte, S., Tshego, D., Rosa, S. A. Dela, Navarro, B., Öllerer, B., Loch, T. K., & Jovanović, M. (2022). *IFSA Membership Report 2021/2022*. https://ifsadotnet-cdn.azureedge.net/wp-content/uploads/2022/08/IFSA-Membership-Report-2021_2022-1.pdf

Huang, J. (2020). Successes and Challenges: Online Teaching and Learning of Chemistry in Higher Education in China in the Time of COVID-19. *Journal of Chemical Education*, *97*(9), 2810–2814. https://doi.org/10.1021/acs.jchemed.0c00671

Innes, J. L., & Ward, D. (2010). Professional Education in Forestry. In *Commonwealth Forests 2010: An overview of the forests and forestry sectors of the countries of the commonwealth* (pp. 76–93).

Isah, A., Aluh, D. O., Abba, A., Chukwu, P. O., Okpara, E. M., Abdullahi, A. S., Igboeli, N. U., Adibe, M. O., & Nworu, C. S. (2021). Impact of the COVID-19 national lockdown on pharmacy students' productivity and their coping strategies in a developing country: An online survey in Nigerian universities. *Pharmacy Education*, 249–259. https://doi.org/10.46542/pe.2020.202.249259

ITTO. (2020). Advancing forestry education in the Congo Basin. *Tropical Forest Update*, *29/1*, 32. https://www.itto.int/direct/topics/topics_pdf_download/topics_id=6430&no=1&disp=inline

IUFRO. (2019). *Outstanding Practices in Forest Education / Joint IUFRO-IFSA Task Force on Forest Education / Task Forces*. https://www.iufro.org/science/task-forces/forest-education/outstanding-practices-forest-education/#c28427

Jacob, O. N. (2020). Effects of COVID-19 Schools Close Down on Academic Programme of Senior Secondary Schools in Abaji Area Council of Federal Capital Territory Abuja, Nigeria. *Electronic Research Journal of Social Sciences and Humanities*, *2*(II), 84–94. http://www.eresearchjournal.com

Jacob, O. N., Somadina, O. I., & Olatunde-Aiyedun, T. . G. (2021). Challenges and Problems of Deployment of ICT Facilities by Public Higher Institutions During Covid-19 in Nigeria.

International Journal of Discoveries and Innovations in Applied Sciences, *1*(4), 30–37.

Jarský, V., Palátová, P., Riedl, M., Zahradník, D., Rinn, R., & Hochmalová, M. (2022). Forest Attendance in the Times of COVID-19—A Case Study on the Example of the Czech Republic. *International Journal of Environmental Research and Public Health*, *19*(5). https://doi.org/10.3390/ijerph19052529

Jeffery, K. A., & Bauer, C. F. (2020). Students' responses to emergency remote online teaching reveal critical factors for all teaching. *Journal of Chemical Education*, *97*(9), 2472–2485. https://doi.org/10.1021/acs.jchemed.0c00736

Jegatheswaran, R., Florin, I., Hazirah, A. L., Shukri, M., Latib, A. S., & Latib, S. A. (2018). Transforming forest education to meet the changing demands for professionals. *Journal of Tropical Forest Science*, *30*(5), 431–438. https://doi.org/10.26525/jtfs2018.30.5.431438

Jegede, D. (2020). Perception of Undergraduate Students on the Impact of COVID-19 Pandemic on Higher Institutions Development in Federal Capital Territory Abuja, Nigeria. *Electronic Research Journal of Social Sciences and Humanities*, *2*(II), 211–222. www.eresearchjournal.com

Johansson, K., Andersson, E., Johansson, M., & Lidestav, G. (2020). Conditioned openings and restraints: The meaning-making of women professionals breaking into the male-dominated sector of forestry. *Gender, Work & Organization*, *27*(6), 927–943. https://doi.org/10.1111/gwao.12403

Johansson, K., Andersson, E., & Sehlstedt, T. (2018). Workplace Harassment in Forestry Organizations – Gendering the Experiences of Women and Men. *Bioproducts Business*, *4*(10), 125–136.

Johansson, M., Johansson, K., & Andersson, E. (2018). *Scandinavian Journal of Forest Research #Metoo in the Swedish forest sector: testimonies from harassed women on sexualised forms of male control #Metoo in the Swedish forest sector: testimonies from harassed women on sexualised forms of male control*. https://doi.org/10.1080/02827581.2018.1474248

Kachaka, C., & Nkwinkwa, D. (2020). Teaching at the heart of SFM: A regional-scale ITTO project has boosted forestry education in the Congo Basin. *Tropical Forest Update*, 6–9. https://www.itto.int/direct/topics/topics_pdf_download/topics_id=6430&no=1&disp=inline

Kammesheidt, L., Idrus, R. M., Trockenbrodt, M., & Hahn-Schilling, B. (2007). Linking academic forestry education with employer's demands: A case study from Malaysia. *International Forestry Review*, *9*(2), 661–669. https://doi.org/10.1505/ifor.9.2.661

Kanowski, P. J. (2020). Multilateral forestry research and tertiary forestry education for development: reflections on progress since the 1970s. *International Forestry Review*, *22*(1), 113–128.

https://doi.org/10.1505/146554820829523961

Kanowski, P. J., Yao, D., & Wyatt, S. (2021). SDG 4 : Quality Education and Forests – ‘ The Golden Thread .’ In *Sustainable Development Goals: Their Impacts on Forests and People* (pp. 108–145). Cambridge University Press. https://doi.org/10.1017/9781108765015.006

Katsvanga, C. A., & Mudyiwa, S. M. (2019). *Training needs analysis and forestry curricula evaluation in professional and technical institutions in Sub-Sahara Anglophone countries* (No. 175; AFF Working Paper). https://afforum.org/wp-content/uploads/2020/07/Vol-4-Issue-2-English.pdf

Keengwe, J., & Kidd, T. T. (2010). Towards Best Practices in Online Learning and Teaching in Higher Education. *MERLOT Journal of Online Learning and Teaching*, *6*(2), 533–541.

Kelly, E. C., & Brown, G. (2019). Who are we educating and what should they know? An assessment of forestry education in California. *Journal of Forestry*, *117*(2), 95–103. https://doi.org/10.1093/jofore/fvy079

Kern, C. C., Kenefic, L. S., & Stout, S. L. (2015). Bridging the Gender Gap: The Demographics of Scientists in the USDA Forest Service and Academia. *BioScience*, *65*(12), 1165–1172. https://doi.org/10.1093/biosci/biv144

Khaoula, B., & Jalal, A. (2021). The Impact of Covid-19 on Higher Education: A Review on the Moroccan Case. *International Journal of Innovation and Economic Development*, *7*(5), 17–26. https://doi.org/10.18775/ijied.1849-7551-7020.2015.75.2002

Kinnula, M., Sánchez Milara, I., Norouzi, B., Sharma, S., & Iivari, N. (2021). The show must go on! Strategies for making and makerspaces during pandemic. *International Journal of Child-Computer Interaction*, *29*, 100303. https://doi.org/10.1016/j.ijcci.2021.100303

Koch, S., & Matviichuk, E. (2021). Patterns of inequality in global forest science conferences: An analysis of actors involved in IUFRO World Congresses with a focus on gender and geography. *Forest Policy and Economics*, *129*(November 2020), 102510. https://doi.org/10.1016/j.forpol.2021.102510

Kolack, K., Hemraj-Benny, T., & Chauhan, M. (2020). Community College Chemistry Instruction and Research in the Time of COVID-19. *Journal of Chemical Education*, *97*(9), 2889–2894. https://doi.org/10.1021/acs.jchemed.0c00700

Komut, O. (2022). The Economic Impacts of Covid-19 on the Forestry Sector: A Case Study in Turkey. *BioResources*, *17*(3), 4030–4042. https://bioresources.cnr.ncsu.edu/resources/the-economic-impacts-of-covid-19-on-the-forestry-sector-a-case-study-in-turkey/

Kung'u, J. B., Muchiri, B. K. B. K., Kuria, A., Kung'u, J. B., & Muchiri, B. K. B. K. (2021). *Regional Assessment of Forest Education in Africa*. www.fao.org/publications

Lambrechts, A. A., Larasatie, P., Boutelier, S., Guta, H. A., Leonowicz-Bukała, I., Martinez-Suarez, A., & Prashad, S. (2021). Why Research Productivity Among Women in Academia Suffered During the Early Stages of COVID-19 Crisis: A Qualitative Analysis. *Pre-Print*, 1–41. https://edarxiv.org/3awdq/

Längin, D. W. W., Ackerman, P. A. A., & Lewark, S. (2004). Internet-based learning in higher forestry education. *Unasylva*, *55*(216), 39–44.

Larasatie, P., Barnett, T., & Hansen, E. (2020). The "Catch-22" of Representation of Women in the Forest Sector: The Perspective of Student Leaders in Top Global Forestry Universities. *Forests*, *11*(4), 1–12. https://doi.org/10.3390/f11040419

Larsen, T., Tabor, L., & Smith, P. (2020). End of the Field? Hacking Online and Hybrid Environments for Field-Based Learning in Geography Education. *Journal of Geography*, *120*(1), 3–11. https://doi.org/10.1080/00221341.2020.1858325

Laudari, H. K., Pariyar, S., & Maraseni, T. (2021). COVID-19 lockdown and the forestry sector: Insight from Gandaki province of Nepal. *Forest Policy and Economics*, *131*, 102556. https://doi.org/10.1016/J.FORPOL.2021.102556

Leiba, M., & Gafni, R. (2021). Zooming?! - Higher Education Faculty Perspectives. *Issues in Informing Science and Information Technology*, *18*, 121–140. https://doi.org/10.28945/4791

Lewark, S. (2021). Keynote: 20 years Bologna – and still more to go? In P. Schmidt, S. Lewark, & N. Weber (Eds.), *Twenty years after the Bologna Declaration - challenges for higher forestry education* (pp. 1–24). Silva Network.

Lewark, S. (2022). Some Thoughts at the End. In *Work in Tropical Forests* (Tropical F, pp. 275–280). Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-662-64444-7_9

Lewark, S., & Karmann, M. (2015). How to design an e-learning course for gender competence. *XIV World Forestry Congress - Forests for People: Investing in a Sustainable Future*, 1–7. https://foris.fao.org/wfc2015/api/file/55490d2b15ae74130aee6c5b/contents/dfe7896e-2025-4c8d-b8f4-b04083580a52.pdf

Lewoń, R., & Pirożnikow, E. (2020). Getting to know the potential of social media in forest education. *Forest Research Papers*, *80*(2), 159–166. https://doi.org/10.2478/frp-2019-0014

Lippe, R. S., Cui, S., & Schweinle, J. (2021). Estimating global forest-based employment. *Forests*,

12(1219), 1–21. https://doi.org/10.3390/f12091219

Long, J. (2021). *Not So Clear Cut: Gender-based Violence in BC's Tree Planting Industry* [University of Victoria]. http://hdl.handle.net/1828/13187

Luchian, I. (2021). The impact of the covid-19 crisis on higher education. *Geopolitical, Social Security and Freedom Journal*, *4*(1), 15–26. https://doi.org/10.2478/gssfj-2021-0002

Macdonald, I. S., Bullen, M., & Kozak, R. A. (2007). Identifying effective pedagogical approaches for online workplace training: A case study of the South African wood products manufacturing sector. *International Review of Research in Open and Distance Learning*, *8*(3), 1–15. https://doi.org/10.19173/irrodl.v8i3.400

Macht, J., Klink-Lehmann, J. L., & Simons, J. (2022). German citizens' perception of the transition towards a sustainable bioeconomy: A glimpse into the Rheinische Revier. *Sustainable Production and Consumption*, *31*, 175–189. https://doi.org/10.1016/j.spc.2022.02.010

Macinnis-Ng, C., & Zhao, X. (2022). Addressing Gender Inequities in Forest Science and Research. *Forests*, *13*(3), 1–23. https://doi.org/10.3390/f13030400

Makruf, I., Rifa'i, A. A., & Triana, Y. (2022). Moodle-based online learning management in higher education. *International Journal of Instruction*, *15*(1), 135–152. https://doi.org/10.29333/iji.2022.1518a

Maraseni, T., Poudyal, B. H., Aryal, K., & Laudari, H. K. (2022). Impact of COVID-19 in the forestry sector: A case of lowland region of Nepal. *Land Use Policy*, *120*(July), 106280. https://doi.org/10.1016/j.landusepol.2022.106280

Masiero, M., Pettenella, D., Secco, L., & Romagnoli, F. (2021). Dealing with Extreme Events and Forest Management: Can Universities have a Role? The Case of the Vaia Storm in Italy. *Twenty Years after the Bologna Declaration – Challenges for Higher Forestry Education.*, 107–121. https://ica-silva.eu/

Masiero, M., Secco, L., Pettenella, D., Da Re, R., Bernö, H., Carreira, A., Dobrovolsky, A., Giertlieova, B., Giurca, A., Holmgren, S., Mark-Herbert, C., Navrátilová, L., Pülzl, H., Ranacher, L., Salvalaggio, A., Sergent, A., Sopanen, J., Stelzer, C., Stetter, T., … Wallin, I. (2020). Bioeconomy perception by future stakeholders: Hearing from European forestry students. *Ambio*, *49*(12), 1925–1942. https://doi.org/10.1007/s13280-020-01376-y

Mgaga, P., & Scholes, M. C. (2019). Does tertiary education in South Africa equip professional foresters for the future? *Southern Forests: A Journal of Forest Science*, *81*(4), 377–385. https://doi.org/10.2989/20702620.2019.1615230

Mogaji, E., & Jain, V. (2020). Impact of the Pandemic on Higher Education in Emerging Countries: Emerging Opportunities, Challenges and Research Agenda. *SSRN Electronic Journal*, *July*, 1–13. https://doi.org/10.2139/ssrn.3622592

Montenegro-rueda, M., Luque-de la Rosa, A., Sánchez-serrano, J. L. S., & Fernández-cerero, J. (2021). Assessment in higher education during the covid-19 pandemic: A systematic review. *Sustainability (Switzerland)*, *13*(19). https://doi.org/10.3390/su131910509

Moosa, R. (2021). Advisors' Perceptions of the Value of Advising Students During the COVID-19 Pandemic: A Case Study at a South African University. *Journal for Students Affairs in Africa*, *9*(2), 65–83. https://doi.org/10.24085/jsaa.v9i2.3699

Muncharaz, J. Z., Carmenado, I. de los R., & Rivera, M. (2015). Education Planning Evolution for Forest Engineering in Spain. *Procedia - Social and Behavioral Sciences*, *197*(February), 1710–1715. https://doi.org/10.1016/j.sbspro.2015.07.224

Mushkarova, O., Mikheeva, M., Tereshchenko, S., Panyutin, A., & Kuznetsov, E. (2020). Increasing the efficiency of the use of forest resources by the digitalization of forest education. *IOP Conference Series: Earth and Environmental Science*, *574*(1), 012054. https://doi.org/10.1088/1755-1315/574/1/012054

Naicker, A., Singh, E., & van Genugten, T. (2022). Collaborative Online International Learning (COIL): Preparedness and experiences of South African students. *Innovations in Education and Teaching International*, *59*(5), 499–510. https://doi.org/10.1080/14703297.2021.1895867

Narayanan, H. (2020). E-Learning dependency and its Influence during COVID-19 with respect to Higher and Tertiary Education. *International Journal of Enhanced Research in Educational Development*, *8*(5), 1–20. https://www.researchgate.net/publication/344592598

Nasir, M. (2020). Impact of the 2019 – 20 coronavirus pandemic on education. *International Journal of Health Preferences Research*, *April*, 1–36.

Ngafeeson, M. N. (2021). Northern Michigan University online campus: A case of digital transformation in higher education. *Journal of Information Technology Teaching Cases*, *0*(0), 1–14. https://doi.org/10.1177/20438869211056950

Nigeria Federal Department of Forestry. (2022). *National Strategy to combat Wildlife and Forest Crime in Nigeria 2022–2026*.

Nöthling, A. C., Khoza, T. E., & Sibiya, M. N. (2022). Benchmarking of Emotional Intelligence in radiography students within KwaZulu- Natal, South Africa. *Radiography*, *28*(2), 487–491. https://doi.org/10.1016/j.radi.2021.10.017

O'Herrin, K., Day, S. D., Wiseman, P. E., Friedel, C. R., & Munsell, J. F. (2018). University student perceptions of urban forestry as a career path. *Urban Forestry and Urban Greening*, *34*(July), 294–304. https://doi.org/10.1016/j.ufug.2018.07.002

O'Neill, G., & Padden, L. (2022). Diversifying assessment methods: Barriers, benefits and enablers. *Innovations in Education and Teaching International*, *59*(4), 398–409. https://doi.org/10.1080/14703297.2021.1880462

Oginni, A., Mogaji, E., & Nguyen, N. P. (2021). Reimagining the place of Physical Buildings in Higher Education in Developing Countries in a Post-COVID-19 Era. In E. Mogaji, V. Jain, F. Maringe, & R. E. Hinson (Eds.), *Re-imagining Educational Futures in Developing Countries* (Issue June). Springer International Publishing. https://doi.org/10.1007/978-3-030-88234-1

Onatunji, A. B. (2021). Choice of Forestry Programme by Undergraduate Students and Willingness to Pursue Further Studies in Selected Universities in Nigeria. In H. R. Elena, A. M. Andres, P. R. Jose, M. C. Laura, V. V. Aitor, A. O. Xabier, & Q. Yunfan (Eds.), *XV Young Researchers Meeting on Conservation and Sustainable Use of Forest Systems* (Issue June, p. 5). Sustainable Forest Management Research Institute, University of Valladolid-INIA. http://sostenible.palencia.uva.es/system/files/publicaciones/abstract_book_young_foresters_2021.pdf

Onatunji, A. B. (2022, April 7). *After 3.5 years, what do we know about forest related employment and green jobs in the forest sector? - IFSA*. https://ifsa.net/after-3-5-years-what-do-we-know-about-forest-related-employment-and-green-jobs-in-the-forest-sector/

Onatunji, A. B., & Babalola, F. D. (2019). Prior Choice of Undergraduate Forestry Programme to Aspiration for Advanced Studies : A Case Study from Nigeria. In *"Twenty Years After The Bologna Declaration - What Are The Challenges Ahead For Higher Forest Education?* SILVA Network on Forest Education.

Onatunji, A. B., Owuor, J. A., Rodriguez-Piñeros, S., Babalola, F. D., Akello, S., & Adeyemi, O. (2021). *Building a Successful Forestry Career in Africa: Inspirational Stories and Opportunities*. International Union of Forest Research Organizations. https://www.iufro.org/fileadmin/material/publications/other-publications/building-a-successful-forestry-career-in-africa.pdf

Owuor, J. A., Giessen, L., Prior, L. C., Cilio, D., Bal, T. L., Bernasconi, A., Burns, J., Chen, X., Goldsmith, A. A., Jiacheng, Z., Kallioniemi, M., Kastenholz, E., Larasatie, P., Lehikoinen, A., Lewark, S., Viana, C. M., de Oliveira, F. E. M., Oberholzer, F., Sharik, T. L., … Winkel, G. (2021). *Trends in forest-related employment and tertiary education: Insights from selected key*

countries around the globe (p. 80). https://efi.int/sites/default/files/files/publication-bank/Trends

Owuor, J. A., & Rodríguez-piñeros, S. (2021). Best Practices in Forest Education in Europe from the Global Best Practices Competition. In P. Schmidt, S. Lewark, & N. Weber (Eds.), *Twenty years after the Bologna declaration – Challenges for higher forestry education.* (pp. 73–84). SILVA Network. https://ica-silva.eu/

Pasiecznik, N., & Reij, C. (2020). *Restoring African Drylands* (Issue 60).

Petruzziello, G., Chiesa, R., & Mariani, M. G. (2022). The Storm Doesn't Touch me!—The Role of Perceived Employability of Students and Graduates in the Pandemic Era. *Sustainability*, *14*(7), 4303. https://doi.org/10.3390/su14074303

Polinko, A. D., & Coupland, K. (2021). Paradigm shifts in forestry and forest research: a bibliometric analysis. *Canadian Journal of Forest Research*, *51*(2), 154–162. https://doi.org/10.1139/cjfr-2020-0311

Prodjomaroeto, T., & Muhyidin, A. (2021). Disrupting Higher Education: Assessing the Impact of COVID-19 on Higher Education Institutions in Indonesia and the United States. *JPP (Jurnal Pendidikan Dan Pembelajaran)*, *27*(2), 48–56. https://doi.org/10.17977/um047v27i22020p048

Pypenko, I. S., Maslov, Y. V., & Melnyk, Y. B. (2020). The Impact of Social Distancing Measures on Higher Education Stakeholders. *International Journal of Science Annals*, *3*(2), 9–14. https://doi.org/10.26697/ijsa.2020.2.2

Ramcilovic-Suominen, S., Puentes Rodriguez, Y., Kirongo, B., & Pitkänen, S. (2016). Higher Forestry Education in Kenya: Bridging the Gap between Educational Training and Job Market Competencies. *International Forestry Review*, *18*(1), 56–67. https://doi.org/10.1505/146554816818206096

Rashid, S., & Yadav, S. S. (2020). Impact of Covid-19 Pandemic on Higher Education and Research. *Indian Journal of Human Development*, *14*(2), 340–343. https://doi.org/10.1177/0973703020946700

Ratnasingam, J., Jegathesan, N., Ab Latib, H., Yi, L. Y., Mariapan, M., Ioras, F., & Abdul Azim, A. A. (2020). Effectiveness of online teaching and learning of wood science and technology courses during the COVID-19 pandemic: Early evidences from a survey of Malaysian universities. *BioResources*, *16*(1), 403–416. https://doi.org/10.15376/biores.16.1.403-416

Rekola, M. (2019). *What could I and my team do to enhance forest education? A report from a Innoduel co-creation survey* (Issue June 4).

Rekola, M., Abbas, D., Bal, T., Burns, J., Lackner, M., Rodriguez, S., & Sharik, T. (2017). *Global Outlook on Forest Education (GOFE): A Pilot Study Report* (Issue October). https://foresteducation.files.wordpress.com/2017/09/gofe_final_report.pdf

Rekola, M., & Lautanen, E. (2015). Perceptions Of Employability and Work- Education Match Among Forestry Graduates in Finland. In P. Schmidt & S. Lewark (Eds.), *From Teaching to Learning – When will we take it seriously in Forest Sciences Education?* (pp. 87–99). SILVA Network on Forest Education.

Rekola, M., Lekah, A., Mala, W. A., Ofusu, S., Boadu, K. B., Onatunji, A. B., Shonowo, D. A., Babalola, F. D., Ofosu, S., Boadu, K. B., Onatunji, A. B., Shonowo, D. A., Babalola, F. D., Ofusu, S., Boadu, K. B., Onatunji, A. B., Shonowo, D. A., & Babalola, F. D. (2019). *Global Outlook on Forest Education (GOFE) A Special Report: Forest Education in Africa* (Issue October). Joint IUFRO-IFSA Task Force on Forest Education (JTF). https://foresteducation.wordpress.com/

Rekola, M., Nevgi, A., & Sandström, N. (2021). *Regional Assesment of Forest Education in Europe*. https://www.fao.org/3/cb6736en/cb6736en.pdf

Rekola, M., Nippala, J., Tynjälä, P., & Virtanen, A. (2018). Modelling competences and anticipating the future competence needs in the forest sector. *Silva Fennica*, *52*(3), 1–19. https://doi.org/10.14214/sf.9983

Rekola, M., Valkeapää, A., & Rantala, T. (2010). Nordic forest professionals' values. *Silva Fennica*, *44*(5), 885–908. https://doi.org/10.14214/sf.127

Reynolds, K. M., Borges, J., Vacik, H., Lexer, M. J., Hetemaki, L., & Nilsson, S. (2005). *Information technology and the forest sector. IUFRO World Series Volume 18*. *March 2016*, 150.

Ringblom, L., & Johansson, M. (2020). Who needs to be "more equal" and why? Doing gender equality in male-dominated industries. *Equality, Diversity and Inclusion: An International Journal*, *39*(4), 337–353. https://doi.org/10.1108/EDI-01-2019-0042

Rizun, M., & Strzelecki, A. (2020). Students' acceptance of the covid-19 impact on shifting higher education to distance learning in Poland. *International Journal of Environmental Research and Public Health*, *17*(18), 1–19. https://doi.org/10.3390/ijerph17186468

Robredo, F. G. (2010). *New Forestry Curricula at the Technical University of Madrid*.

Rodríguez-Piñeros, S., Walji, K., Rekola, M., Owuor, J. A., Lehto, A., Tutu, S. A., & Giessen, L. (2020). Innovations in forest education: Insights from the best practices global competition. *Forest Policy and Economics*, *118*(March), 102260. https://doi.org/10.1016/j.forpol.2020.102260

Roos, A., Blomquist, M., Bhatia, R., Ekegren, K., Rönnberg, J., Torfgård, L., & Tunberg, M. (2021). The digitalisation of the Nordic bioeconomy and its effect on gender equality. *Scandinavian Journal of Forest Research*, *36*(7–8), 639–654. https://doi.org/10.1080/02827581.2021.1996629

Sample, V. A., Bixler, R. P., McDonough, M. H., Bullard, S. H., Snieckus, M. M., Alaric Sample, V., Patrick Bixler, R., McDonough, M. H., Bullard, S. H., & Snieckus, M. M. (2015). The Promise and Performance of Forestry Education in the United States: Results of a Survey of Forestry Employers, Graduates, and Educators. *Journal of Forestry*, *113*(6), 528–537. https://doi.org/10.5849/jof.14-122

Sansom, R. L. (2020). Pressure from the pandemic: Pedagogical dissatisfaction reveals faculty beliefs. *Journal of Chemical Education*, *97*(9), 2378–2382. https://doi.org/10.1021/acs.jchemed.0c00657

Sanz-Hernández, A., Jiménez-Caballero, P., & Zarauz, I. (2022). Gender and women in scientific literature on bioeconomy: A systematic review. *Forest Policy and Economics*, *141*(102762), 1–15. https://doi.org/10.1016/j.forpol.2022.102762

Sauphayana, S. (2021). Innovation in higher education management and leadership. *Journal of Educational and Social Research*, *11*(6), 163–172. https://doi.org/10.36941/jesr-2021-0137

Scott, F. J., & Willison, D. (2021). Students' reflections on an employability skills provision. *Journal of Further and Higher Education*, *45*(8), 1118–1133. https://doi.org/10.1080/0309877X.2021.1928025

Searle, S., & Bryant, C. (2009). Why students choose to study for a forestry degree and implications for the forestry profession. *Australian Forestry*, *72*(2), 71–79. https://doi.org/10.1080/00049158.2009.10676292

Sharik, T. L., Lilieholm, R. J., Lindquist, W., & Richardson, W. W. (2015). Undergraduate Enrollment in Natural Resource Programs in the United States: Trends, Drivers, and Implications for the Future of Natural Resource Professions. *Journal of Forestry -Washington-*, *113*(6), 538–551. https://doi.org/10.5849/jof.14-146

Shiraef, M. A., Friesen, P., Feddern, L., Weiss, M. A., Team, C., & COBAP Team. (2022). Did border closures slow SARS-CoV-2? *Scientific Reports*, *12*(1709), 1–13. https://doi.org/10.1038/s41598-022-05482-7

Shirley, H. L., Shirley, L., Innes, B. J. L., & Innes, J. L. (2010). Professional education in forestry. In *Commonwealth Forests* (pp. 76–93). http://www.fao.org/3/18587e/18587e03.htm

Shyju, P. J. J., Vinodan, A., Sadekar, P., Sethu, M., & Lama, R. (2021). Determinants of online learning efficacy and satisfaction of tourism and hospitality management students during the COVID-19

pandemic. *Journal of Teaching in Travel & Tourism*, *21*(4), 403–427. https://doi.org/10.1080/15313220.2021.1998941

Simon, L. E., Genova, L. E., Kloepper, M. L. O., & Kloepper, K. D. (2020). Learning postdisruption: Lessons from students in a fully online nonmajors laboratory course. *Journal of Chemical Education*, *97*(9), 2430–2438. https://doi.org/10.1021/acs.jchemed.0c00778

Singh, A. K., & Chander, M. (2020). Covid-19 and Higher Education. *Aegaeum*, *8*(9), 1–21. https://www.researchgate.net/publication/344570214_COVID_19_and_Higher_Education

Sobral, S. R., Jesus-Silva, N., Cardoso, A., & Moreira, F. (2021). EU27 Higher Education Institutions and COVID-19, Year 2020. *International Journal of Environmental Research and Public Health*, *18*(11), 5963. https://doi.org/10.3390/ijerph18115963

Srivastava, S., Jacob, J., Charles, A. S., Daniel, P., Mathew, J. K., Shanthi, P., Devamani, K., Mahasampath, G., & Rabi, S. (2021). Emergency remote learning in anatomy during the COVID-19 pandemic: A study evaluating academic factors contributing to anxiety among first year medical students. *Medical Journal Armed Forces India*, *77*, S90–S98. https://doi.org/10.1016/j.mjafi.2020.12.012

Stanturf, J. A., & Mansuy, N. (2021). COVID-19 and Forests in Canada and the United States: Initial Assessment and Beyond. *Frontiers in Forests and Global Change*, *4*(July), 1–16. https://doi.org/10.3389/ffgc.2021.666960

Sultanova, L., Milto, L., & Zheludenko, M. (2021). The Impact of the Covid-19 Pandemic on the Development of Higher Education. *Acta Paedagogica Vilnensia*, *46*(September), 132–147. https://doi.org/10.15388/ActPaed.46.2021.9

Sun, P. C., Tsai, R. J., Finger, G., Chen, Y. Y., & Yeh, D. (2008). What drives a successful e-Learning? An empirical investigation of the critical factors influencing learner satisfaction. *Computers and Education*, *50*(4), 1183–1202. https://doi.org/10.1016/j.compedu.2006.11.007

Tahvanainen, L. (2003). Introduction. In L. Tahvanainen & P. Pelkonen (Eds.), *ICT in Higher Forestry Education: Proceedings of the SILVA European Conferences held in Warsaw, Poland 5th of September 2002 and in Beauvais, France 5th of April 2003*. SILVA Network.

Talal, M. L., & Gruntman, M. (2022). What Influences Shifts in Urban Nature Site Visitation During COVID-19? A Case Study in Tel Aviv-Yafo, Israel. *Frontiers in Environmental Science*, *10*(May), 1–14. https://doi.org/10.3389/fenvs.2022.874707

Tavares, C., & Borges, J. G. (2021). MEDFOR: The Experience of an Erasmus Mundus Master Programme in Forestry and Natural Resources. In P. Schmidt, S. Lewark, & N. Weber (Eds.),

Twenty years after the Bologna declaration – Challenges for higher forestry education June 19 - 21, 2019. (pp. 57–65). SILVA Network on Forest Education. https://ica-silva.eu/

Tereshchenko, S., Zagorskaya, M., Polyanskaya, O., & Bobritskaya, J. (2020). Mobile learning in forestry education. *IOP Conference Series: Earth and Environmental Science*, *507*(1), 012031. https://doi.org/10.1088/1755-1315/507/1/012031

Tice, D., Baumeister, R., Crawford, J., Allen, K.-A., & Percy, A. (2021). Student belongingness in higher education: Lessons for Professors from the COVID-19 pandemic. *Journal of University Teaching and Learning Practice*, *18*(4), 8–20. https://doi.org/10.53761/1.18.4.2

Twesige, D., Gasheja, F., Isae Misago, K., & Muvunyi, E. (2021). COVID-19's Impact on the Student Learning Process in Rwandan Higher Education Institutions. *International Journal of African Higher Education*, *8*(3), 144–160. https://doi.org/10.6017/ijahe.v8i3.14167

Udem, O. K., Ejike, T. K., & Okpalibekwe, U. (2021). COVID-19 and Future of Tertiary Education in Nigeria. In M. N. Umenweke, K. M. Alumona, M. H. C. Madubueze, J. O. Nwankwo, C. S. Ekesiobi, & C. N. E. Etodike (Eds.), *Contemporary Issues on Covid-19 Experiences in Nigeria* (Issue July). John Archers (Publishers) LTD. https://doi.org/10.2139/ssrn.3883147

UNDESA, & UNFF. (2021). *The Global Forest Goals Report 2021*. www.un.org/esa/forests.

UNEP. (2020). *Zoonotic Diseases* (p. 2). United Nations Environment Programme. http://www.unep.org

UNEP. (2021). *Investing in forests to build back better & greener* (p. 1).

UNESCO. (2020). COVID-19 and higher education: Today and tomorrow. In *UNESCO International Institute for Higher Education in Latin America and the Caribbean (IESALC)*. https://bit.ly/34TOSvu

UNESCO, UNICEF, The World Bank, & OECD. (2021). *What's next? Lessons on Education Recovery: Findings from a Survey of Ministries of Education amid the Covid-19 Pandemic*.

UNFF. (2019). *Global Forest Goals and Targets of the UN Strategic Plan for Forests 2030* (p. 20). The United Nations. http://www.un.org/esa/forests

UNICEF. (2021). *The State of the World's Children 2021: On My Mind – Promoting, protecting and caring for children's mental health*. https://www.unicef.org/media/114636/file/SOWC-2021-full-report-English.pdf

Vega-garcia, C., & Alcázar, J. (2016). Lifelong learning in forestry : a short summary of trends in Spain. In P. Schmidt, H. Hasenaeur, & S. Lewark (Eds.), *Should all Forestry Students learn the*

same? Generalist versus Specialist Approach - SILVA Network Conference 2015 (pp. 96–101). University of Freiburg, Germany. https://www.researchgate.net/publication/311000563_Lifelong_learning_in_forestry_a_short_summary_of_trends_in_Spain

Villarraga-Flórez, L. F., Rodríguez-Piñeros, S., & Martínez-Cortés, O. G. (2016). Social science in forestry curricula: A case study of Colombia forestry programs. *Sustainability (Switzerland)*, *8*(1), 1–10. https://doi.org/10.3390/su8010036

Walmsley, J. D. (2016, April). Transforming forestry students into forestry professionals. *Forestry and Timber News*, *April*, 21. https://www.researchgate.net/publication/301673945

Wang, X., Tan, S. C., & Li, L. (2020). Technostress in university students' technology-enhanced learning: An investigation from multidimensional person-environment misfit. *Computers in Human Behavior*, *105*(1), 106208. https://doi.org/10.1016/j.chb.2019.106208

Wang, Y.-M., Chiu, W.-C., Lin, H.-H., Wang, Y.-S., Wang, Y.-Y., & Chen, I.-F. (2022). Determinants of students' adoption of virtual reality-based learning systems: An individual difference perspective. *Innovations in Education and Teaching International*, 1–11. https://doi.org/10.1080/14703297.2022.2098512

Weerawardane, D. (2021). Digital transformation of Higher Education: what's next? *New Vistas*, *7*(2), 1–6. https://doi.org/10.36828/newvistas.147

Weinbrenner, H., Breithut, J., Hebermehl, W., Kaufmann, A., Klinger, T., Palm, T., & Wirth, K. (2021). "The Forest Has Become Our New Living Room" – The Critical Importance of Urban Forests During the COVID-19 Pandemic. *Frontiers in Forests and Global Change*, *4*(June), 1–19. https://doi.org/10.3389/ffgc.2021.672909

WHO. (2020). *WHO Director-General's opening remarks at the media briefing on COVID-19 - 11 March 2020*. https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020

WHO. (2022a). *Coronavirus overview*. https://www.who.int/health-topics/coronavirus#tab=tab_1

WHO. (2022b). *WHO Coronavirus (COVID-19) Dashboard | WHO Coronavirus (COVID-19) Dashboard With Vaccination Data*. https://covid19.who.int/

WHO Regional Office for Africa. (2022). *Coronavirus (COVID-19) Pandemic in Africa*. https://www.afro.who.int/health-topics/coronavirus-covid-19

WHO Regional Office for Europe. (2022). *Coronavirus disease (COVID-19) pandemic in Europe*.

https://www.who.int/europe/emergencies/situations/covid-19

Wilson, E. (2022). *Challenges and opportunities in educating the next generation of foresters* (p. 4).

Wilson, T. (n.d.). So you want to work in Forestry? *Forestry Journal*, *1*(15), 22–23. https://www.confor.org.uk/media/79559/22-23-career-in-forestry.pdf

Wunder, S., Kaimowitz, D., Jensen, S., & Feder, S. (2021). Coronavirus, macroeconomy, and forests: What likely impacts? *Forest Policy and Economics*, *131*, 102536. https://doi.org/10.1016/j.forpol.2021.102536

Yoon, H., & Mecca, M. (2022). Fieldwork from desktop: webdoc for teaching in the time of pandemic. *Journal of Geography in Higher Education*, *00*(00), 1–20. https://doi.org/10.1080/03098265.2022.2045575

Younis, H., & Elbanna, S. (2022). Teaching in times of crisis: The impact of the COVID-19 pandemic on higher education. *Innovations in Education and Teaching International*, 1–12. https://doi.org/10.1080/14703297.2022.2060850

Zeng, M. Q. M., Chen, H., Shrestha, A., Crowley, C., Ng, E., & Wang, G. (2020). International collaboration on a sustainable forest management OER online program - A case study. *Journal of Higher Education Theory and Practice*, *20*(8), 120–128. https://doi.org/10.33423/jhetp.v20i8.3235

Zhang, Y., Zhang, P., Yang, H., Zhao, K., & Han, C. (2021). Influencing Factors of Students' Online Learning Satisfaction During the COVID-19 Outbreak: An Empirical Study Based on Random Forest Algorithm. *Lecture Notes in Computer Science*, *12511 LNCS*, 103–114. https://doi.org/10.1007/978-3-030-66906-5_10

Zhou, C.-M., Qin, X.-R., Yan, L.-N., Jiang, Y., & Yu, X.-J. (2022). Global trends in COVID-19. *Infectious Medicine*, *1*(1), 31–39. https://doi.org/10.1016/j.imj.2021.08.001

Annex

This section provides other materials used in this study.

Section A: Questionnaire used for the study

The study used an online platform to collect primary data used for this study. Two questionnaires were developed, one targeted at the students and the other focusing on lecturers. To ensure that data collection is seamless and with the use of advanced skip logic, only one link is shared as both surveys were combined into one.

For better comprehension and understanding, the questionnaire is divided into two in this appendix.

Annex 1: Student questionnaire version

Questionnaire for a MSc thesis on the impacts of COVID-19 Pandemic on teaching and learning Forest Science in Africa and Europe

Introduction
Dear Sir/Ma,

My name is Alex B. Onatunji. I am an MSc. student in the Erasmus Mundus Master Programme in Mediterranean Forestry and Natural Resources Management (MEDfOR), University of Padova, Italy. I am developing my Master's thesis exploring the impacts of COVID-19 Pandemic on teaching and learning Forest Science in some African and European case-study countries, trying to extract lessons that can be useful to students and professors in other regions and in future.

Introduction to the survey
You have received this survey because your university has been selected for this study. This survey consists of an online questionnaire structured into seven sections – focusing on your knowledge and perception of how the COVID-19 pandemic has affected and still affects the delivery of forest education – and will take about 15 - 30 minutes of your time.

Your responses will be analyzed and compared with those of your colleagues from the selected countries. All forestry students – including Bachelor's, Master's, and PhD ones – from the universities chosen can participate in this survey.

- Okay (mandatory)

Privacy notice
Data collected through this survey will be treated confidentially and anonymously, elaborated, and used in aggregated forms, exclusively for my thesis research purposes, complying with the General Data Protection Regulation (GDPR), Regulation (EU) 2016/679 as well as with the new "Code for the Integrity of the Research" approved by the University of Padova on the 14.09.2021. You permit me to process the data you provide for this project research by filling in the questionnaire.

Thank you,

Alex Bimbo Onatunji
alexbimbo.onatunji@studenti.unipd.it
+2348102394713

- **Okay (mandatory)**

How the form works

The survey includes skip logic function; therefore, you may not see some questions based on your previous response. The form is also dynamic for use – you can edit your responses before submitting. I understand this.

- Okay (mandatory)

The COVID-19 pandemic is not over yet

As at May 2022, the COVID-19 pandemic is "most certainly not over," said the head of the World Health Organization. Therefore, this study assumes that we are still in the pandemic era, though the intensity has reduced. This will help in your perception as you answer the questionnaire.

- **Okay (mandatory)**

* means questions with multiple response possible.

Section A: Perspective on virtual teaching before and during the COVID-19 pandemic

Please pick the right option.

1. **Were online/virtual teaching adopted in all the courses of your forest science programme (all levels)?**

No
Yes, before pandemic only
Yes, during pandemic only
Yes, before and during pandemic

2. Which platforms did your university use for online video lectures before and during the pandemic for forest sciences programmes?* (Students that pick YES in Q1) Please choose a response for each of the row.	**Before and during pandemic**	**Before pandemic only**	**During pandemic only**	**Not applicable**
Blackboard Collaborate				
Google Meet				
Microsoft Teams				
Skype				
Webex				
YouTube (pre-recorded lectures)				
Zoom				
None, my university does not have such facilities				
Others (specify):.....				

- b. Others (specify): .....

3. Did your university hosted course content on any learning platform(s)?

Please pick the right option for you

Yes, integrated as part of university website

Yes, through an external learning platform.

No, course content is not hosted online

Not applicable

4. Which platforms did your university host course content online for forest science programme before and during the pandemic?* (Students that pick YES in Q3) Please choose a response for each of the row.	**Before and during pandemic**	**Before pandemic only**	**During pandemic only**	**Not applicable**
Campus Virtual				
Google Classroom				
Microsoft Education				
Moodle				
None, my university does not have such facilities				
Others (specify): ……...				

- b. Others (specify): .....

5. Did you use the learning platform(s) your university hosted course content?

Yes, I use them frequently

Yes, I use them rarely

No, I did not use them

Not applicable

6. Which of the following options were available for students to attend lectures before and during the pandemic?* (Students and that pick YES in Q1) Please choose a response for each of the row.	**Before and during pandemic**	**Before pandemic only**	**During pandemic only**	**Not applicable**
A full degree programme can be taught entirely online				
In-person (face to face) only				
Online - synchronous				
Online - asynchronous				
Partial synchronous and partial asynchronous				
Hybrid for all – lecturer can teach students in a classroom via videoconferencing.				
Hybrid – students can choose to attend lectures online or face-to-face in class				
Others (specify): ……...				

- 6b. Others (specify): .....

7. Do your lecturers record lecturers during online classes? (Students that pick YES in Q1)

Yes, it is required by my university

Yes, at the discretion of individual lecturers

Yes, but it depends on the platforms used

No, it is not allowed by my university

No, our platforms are not capable of recording

8. Which of the following statements are applicable to you as regards the recording of online classes?* (Students that pick YES options in Q7)

Choose as many options as applicable to you.
I like the lectures to be recorded
I don't see the need for the lectures to be recorded
I feel comfortable if my voice and video are recorded with the lectures
Not applicable

9. How do you want the classes recordings to be used?* (Students that pick YES in Q7)

Choose as many options as applicable to you.
Lecturers and the university should have access to the recordings
Class students should have access to the recordings
The recordings should be made public and perpetually for whosoever needs them
The recordings should be in the possession of the lecturer only
Not applicable

10. How do you personally use the classes recordings?* (Students that pick YES in Q7)

Choose as many options as applicable to you.
The recordings are not available to students
I have never watched the recordings back
I have watched the recordings only on a few occasions
I frequently watch the recordings
Not applicable

11. How long do you want the recordings to be made available? (Students that pick YES in Q7)

1 – 2 months
3 – 6 months
7 – 12 months
Perpetually available
Not applicable

12. Are you satisfied with the quality of video recordings of online classes in your university? (Students that pick YES in Q7)

Yes, they are perfect
Maybe, the quality can be improved
No, the quality is poor
Not applicable

Section Bi: Challenges faced by forestry students during the COVID-19 pandemic

Kindly express your grade of agreement/disagreement with the following statements using a scale from 5 (Strongly Agree) to 1 (Strongly disagree).

S/N	Statements	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly disagree (1)
13.	I missed going on field trips					
14.	I missed laboratory work					

15.	I missed learning an important topic of interest because an entire course was cancelled due to Covid restrictions					
16.	I missed the interactions I used to have with my colleagues and lecturers before and after lectures					
17.	I had challenge preparing and taking examinations online					
18.	I lost access to the university library resources					
19.	I lost access to the university computer labs					
20.	I did not have free and fast internet at home					
21.	I missed the positive relationships I have with my professors					
22.	I had less access to career counselling and support services					
23.	I had difficulties finding an internship/traineeship placement					

24. Please type other challenges you faced that are not covered in the list above (OPTIONAL)
Please type text.
.....
.....
.....

Section Bii: Challenges experienced and communicated during online learning activities
Please pick the appropriate responses for the following statements on how the pandemic affected your life and studies, and if they were communicated to the university authority.

NE = Not experienced; EA= Experienced but not communicated; and EC: Experienced and communicated to the university

S/N	Statements	Not experienced	Experienced but not communicated	Experienced and communicated to the university
25.	I contracted and recovered from COVID-19 virus			
26.	I experienced loneliness or isolation because I could not have physical connections with other students/peers and/or friends/relatives			
27.	I was troubled motivating myself to attend online lectures, watch lectures videos or complete my online assignment			
28.	I had problems with access to a working computer			
29.	I had problems with internet connection (availability, speed, reliability, etc.)			
30.	I experienced difficulties with online learning because it does not match my learning style			
31.	I had difficulties with being focus and time management			
32.	My studies/lab/fieldwork was delayed			
33.	My scholarship/funding was negatively affected			

34. Please type other challenges you experienced and/or communicated with the university that are not covered in the list above (OPTIONAL)

Please type text.

.....

.....

.....

Section C: Prospects of online learning of forest sciences post COVID-19 pandemic

Please pick the appropriate ranking/response of the following statements based on your perception or experience.

SA = Strongly Agree (5); A= Agree (4); N = Neutral (3); D = Disagree (2); SD: Strongly disagree (1); and Not applicable (0)

S/N	Statements	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly disagree (1)	Not applicable (0)
35.	I prefer Virtual Reality (VR)/ online teaching to replace some fieldwork						
36.	I now have flexible studying hours due to online teaching methods						
37.	I prefer online teaching method and use of video conferencing tools in compared to face-to-face only because they allow invitation and presence of guest lecturers from other universities/institutions						
38.	I prefer online teaching/learning platforms to face-to-face only because they allow us as students to collaborate with peers in other universities and locations						
39.	The pandemic has opened the opportunity to introduce new and emerging topics such as Greencare, forest and human health, etc. to students						
40.	I had the opportunity to avoid professors I have negative relationships with						
41.	I have opportunity to be engaged in more extra-curricular activities e.g., voluntary activities						
42.	I have opportunity to combine studies and work						
43.	The pandemic has helped students to enhance their soft skills such as collaboration, working in a team, and use of ICT tools etc.						

44. Please state other prospects that you think of that were not provided in the list above (OPTIONAL)

.....

45. Which of the following activities have your university explored since the beginning of the pandemic?*

Please choose as many options as applicable to you.
Used videos to replace some field concepts
Invited guest lecturers from other universities and research institutions
Invited guest lecturers from forestry companies and organizations
Facilitating an inter-university collaboration of lecturers and students within my country
Facilitating an inter-university collaboration of lecturers and students internationally
Explored the intersections of forest and COVID-19 in my research
Not applicable
Others (specify):_____

- 45b. Others (specify): .....

46. Which of the following examination modes have been explored in your university since the beginning of the pandemic as a lecturer?*

Please choose as many options as applicable to you.
My exams are conducted face-face
Exams conducted entirely online in an interview style
Exams conducted entirely online through structured questions on an online platform
Fewer or shorter exams are conducted
Exams eliminated entirely
Nothing has changed in my university examination techniques
Others (specify):_____

- 46b. Others (specify): .....

Section D: Looking beyond teaching and learning forest science in COVID-19 pandemic era

Please pick the correct response to the following question based on your perception of the pandemic impact in the next 5 years.

S/N	Statements	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly disagree (1)	Not applicable (0)
47.	I feel that new jobs and career prospects will be available in the forest sector generally, e.g. Greencare						
48.	I feel that more future forestry professionals would like to work more indoor						

49.	I feel that the university has done its best to help graduates to transition to the real world of the forest profession despite the pandemic						
50.	I feel that the generation of forestry students taught during the pandemic will have better ICT and computer skills						
51.	I feel the quality of forest education delivered during the pandemic was compromised due to the shift to online teaching						
52.	I feel that the generation of forestry students taught during the pandemic will have weaker technical skills						
53.	I feel that the generation of forestry students taught during the pandemic will have weaker social and soft skills						
54.	I feel that students have acquired limited knowledge due to pandemic						
55.	I feel that new forest science graduates will not be recognized as well-prepared and qualified professionals						
56.	I feel that teaching and learning forest science in the era of the pandemic will negatively impact the ability of forestry graduates to find a job (employability) in the next 5 years						
57.	I feel that this virtual teaching of forest science will also negatively affect the way how forests are managed and will be managed						
58.	I would appreciate it if intercontinental exchange programmes could be initiated for forestry students and lecturers virtually						
59.	I would appreciate it if intercontinental exchange programmes could be initiated for forestry students and lecturers face-face						

60. Please share any other direct and short-term outcomes of the pandemic on forest education that you think of (OPTIONAL)

Please type .....
.....
.....

61. What is the word that best describes your overall perspective of learning forest sciences in the pandemic era? .....

62. Any other comments regarding learning and teaching forestry in the COVID-19 pandemic era you would like to share or add (OPTIONAL) .....
.....
.....

63. Will you like to receive an abstract of the findings of this survey?

Yes
No

- 63b. If yes, kindly provide your email address **(OPTIONAL)**

64. Will you like to be invited to a focus group discussion for 1 hour on Zoom?

Yes
No

- 63bb. If yes, kindly provide your email address **(OPTIONAL)**

Section E: Background information and demographic characteristics of respondents

65. Which continent is your university located?

Please select one
Africa
Europe

66. Country

Italy
Kenya
Uganda
Nigeria
Spain

67. Select your university name

Federal University of Technology Akure
Kenyatta University
Maasai Mara University
Makerere University
Ndejje University
University of Eldoret
University of Florence
University of Ibadan
University of Ilorin
University of Lleida
University of Maiduguri
University of Padova
University of Tuscia
University of Valladolid

68. Age

Less than 18 years
18 – 24 years
25 – 34 years
35 – 44 years
45 – 54 years

55 – 64 years
65 and above

69. Gender

Male
Female
I prefer not to say

70. Nationality of the respondent

Type your country of origin

71. The current level of studies

Bachelors or equivalent
Masters or equivalent
PhD or equivalent

72. Degree/programme title

Please type your degree title

73. Are you an Erasmus student, or are you participating in another exchange program (Joint Study, CEEPUS, etc.)?

Please choose one of the following answers.
Yes, Erasmus
Yes, Erasmus Mundus
Yes, CEEPUS
Yes, Joint Study
No
Other (please specify) .....

Annex 2: Lecturer questionnaire version

Questionnaire for a MSc thesis on the impacts of COVID-19 Pandemic on teaching and learning Forest Science in Africa and Europe

Introduction
Dear Sir/Ma,

My name is Alex B. Onatunji. I am an MSc. student in the Erasmus Mundus Master Programme in Mediterranean Forestry and Natural Resources Management (MEDfOR), University of Padova, Italy. I am developing my Master's thesis exploring the impacts of COVID-19 Pandemic on teaching and learning Forest Science in some African and European case-study countries, trying to extract lessons that can be useful to students and professors in other regions and in future.

Introduction to the survey
You have received this survey because your university has been selected for this study. This survey consists of an online questionnaire structured into seven sections – focusing on your knowledge and perception of how the COVID-19 pandemic has affected and still affects the delivery of forest education – and will take about 15 - 30 minutes of your time.

Your responses will be analyzed and compared with those of your colleagues from the selected countries. All forestry lecturers (irrespective of position) the universities chosen can participate in this survey.

- Okay (mandatory)

Privacy notice
Data collected through this survey will be treated confidentially and anonymously, elaborated, and used in aggregated forms, exclusively for my thesis research purposes, complying with the General Data Protection Regulation (GDPR), Regulation (EU) 2016/679 as well as with the new "Code for the Integrity of the Research" approved by the University of Padova on the 14.09.2021. You permit me to process the data you provide for this project research by filling in the questionnaire.

Thank you,

Alex Bimbo Onatunji
alexbimbo.onatunji@studenti.unipd.it
+2348102394713

- Okay (mandatory)

How the form works
The survey includes skip logic function; therefore, you may not see some questions based on your previous response. The form is also dynamic for use – you can edit your responses before submitting. I understand this.

- Okay (mandatory)

The COVID-19 pandemic is not over yet

As at May 2022, the COVID-19 pandemic is "most certainly not over," said the head of the World Health Organization. Therefore, this study assumes that we are still in the pandemic era, though the intensity has reduced. This will help in your perception as you answer the questionnaire.

- Okay (mandatory)

Section A: Perspective on virtual teaching before and during the COVID-19 pandemic
Please pick the right option.

1. **Were online/virtual teaching adopted in all the courses of your forest science programme (all levels)?**

No
Yes, before pandemic only
Yes, during pandemic only
Yes, before and during pandemic

2. Which policies regarding teaching forest science online have been adopted by your university before and during the pandemic? (Lecturers that pick YES in Q1) **Please choose a response for each of the row.**	**Before and during pandemic**	**Before pandemic only**	**During pandemic only**	**Not applicable**
A full degree programme can be taught entirely online				
A course or module can be taught entirely online (100%)				
50% of a course or module can be taught online				
25% of a course or module can be taught online				
Less than 25% of a course or module can be taught online				
Others (specify):				

- **2b. Others (specify): .....**

3. Which platforms did your university use for online video lectures before and during the pandemic for forest sciences programmes?* **(Lecturers that pick YES in Q1)** **Please choose a response for each of the row.**	**Before and during pandemic**	**Before pandemic only**	**During pandemic only**	**Not applicable**
Blackboard Collaborate				
Google Meet				
Microsoft Teams				
Skype				
Webex				
YouTube (pre-recorded lectures)				
Zoom				

None, my university does not have such facilities				
Others (specify):.....				

- **3b. Others (specify): .....**

4. **Briefly explain why did you chose the platform you mentioned above as a lecturer (Lecturers that pick YES in Q3)?**

Please type text

.....
.....

5. **Did your university hosted course content on any learning platform(s)?**

Please pick the right option for you
Yes, integrated as part of university website
Yes, through an external learning platform.
No, course content is not hosted online
Not applicable

6. Which platforms did your university host course content online for forest science programme before and during the pandemic?* (Lecturers that pick YES in Q5) Please choose a response for each of the row.	**Before and during pandemic**	**Before pandemic only**	**During pandemic only**	**Not applicable**
Campus Virtual				
Google Classroom				
Microsoft Education				
Moodle				
None, my university does not have such facilities				
Others (specify): …….				

- 6b. Others (specify): .....

7. **Did you use the learning platform(s) your university hosted course content?**

Yes, I use them frequently
Yes, I use them rarely
No, I did not use them
Not applicable

8. Did your university provide any pedagogy training to professors/lecturers on delivering lectures online "before and during the pandemic? (Lecturers that pick YES in Q1) ***Please choose a response for each of the row.***	**Before and during pandemic**	**Before pandemic only**	**During pandemic only**	**Not applicable**

Yes, and I used or attended them				
Yes, but I did not use or attend them				
Yes, through an external learning platform				
No, none was provided				

9. Which of the following options were available for students to attend lectures before and during the pandemic?* ***(Lecturers that pick YES in Q1)*** ***Please choose a response for each of the row.***	**Before and during pandemic**	**Before pandemic only**	**During pandemic only**	**Not applicable**
In-person (face to face) only				
Online - synchronous				
Online - asynchronous				
Partial synchronous and partial asynchronous				
Hybrid for all – lecturer can teach students in a classroom via videoconferencing.				
Hybrid – students can choose to attend lectures online or face-to-face in class				
Others (specify): ….....				

- 9b. Others (specify): .....

10. Institutional freedom for course delivery modality due to the pandemic for lecturers

Lecturers have complete freedom to select course modality (in-person, hybrid, remote/online)
Lecturers can select course modality but were encouraged to choose remote/online options
Lecturers can select course modality but were encouraged to choose in-person options
Remote/online options compulsory for all courses
Others (specify):.....

- 11b. Others (specify): .....

11. Do you record your lectures during online classes?

Yes, it is required by my university
Yes, at the discretion of individual lecturers
Yes, but it depends on the platforms used
No, it is not allowed by my university
No, I don't feel comfortable doing so

12. Why do you record your lectures?*

For students to have access to go back to re-watch them later
For students missing the original presentation
To make the lectures publicly available online, e.g., on YouTube
For my archival purpose
Others (specify):_____

- 12b. Others (specify): .....

13. Are you satisfied with the quality of video recordings of online classes in your university? (Lecturers that pick YES in Q11)

Yes, they are perfect
Maybe, the quality can be improved
No, the quality is poor
Not applicable

14. During the pandemic, did you modify your assignments every academic year as a lecturer?

Yes
No
Partially

15. What are some of the reasons behind the modification of assignments during the pandemic?* (Lecturers that pick YES in Q14)

Please choose as many options as applicable to you.
Added new assignments
Adjusted the assignments focus/length/structure to account for the change in the course delivery
Consolidated and reduced the number of assignments typically assigned
Typical tweak I make to assignments every year
Others

16. Despite the pandemic, are there courses/module that are still delivered exclusively face-to-face only?

Yes
No
I don't know

Section Bi: Challenges faced by Lecturers during the COVID-19 pandemic
Please pick the appropriate ranking of the following statements.

S/N	Statements	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly disagree (1)
17.	I got some income constraints because one of my courses was deleted, and I got lower salary					
18.	I had conflict with my official work and family responsibilities					
19.	I had difficulties with redesigning my academic work from face-to-face to online or mixed teaching mode					
20.	I had to stop field visits due to the pandemic					
21.	I had to stop laboratory research due to the lockdown					
22.	I missed the interactions I used to have with students before and after lectures					

23.	My course load and work hours were increased due to the pandemic					
24.	I published less papers because it was not possible to collect primary data for more than 2 years					

25. Please type other challenges you faced that are not covered in the list above (OPTIONAL)

Please type text. .....
.....
.....

Section Bii: Challenges experienced and communicated during online teaching

Please pick the appropriate responses for the following statements on how the pandemic affected your life and studies, and if they were communicated to the university authority.

S/N	Statements	Not experienced	Experienced but not communicated	Experienced and communicated to the university
26.	I had difficulties with focus and time management			
27.	I have contracted and recovered COVID-19 virus myself			
28.	I experienced loneliness or isolation with lockdown and restrictions			
29.	I had trouble motivating my students to attend lectures, watch lecture videos or complete my online assignment			
30.	I experienced difficulties organizing examinations online			
31.	My research funding has been negatively affected			
32.	I experienced delay in my research/lab/fieldwork			
33.	I had difficulties with delivering my lectures online because it does not match my teaching style			
34.	I had problems with internet connection (availability, speed, reliability) etc.			
35.	I have the perception that the number of women enrolled in forestry courses in my university has decreased due to the pandemic			
36.	The limited availability and presence at work of technical and administrative staff have impacted my research and teaching negatively			

37. Please type other challenges you experienced and/or communicated with the university that are not covered in the list above (OPTIONAL)

Please type text.....
.....

Section C: Prospects of online teaching of forest sciences post COVID-19 pandemic

Please pick the appropriate ranking/response of the following statements based on your perception or experience.

S/N	Statements	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly disagree (1)	Not applicable (0)
38.	I prefer Virtual Reality (VR)/ online teaching to replace some fieldwork						
39.	I now have flexible studying/working hours due to online teaching methods						
40.	I prefer online teaching method and use of video conferencing tools in compared to face-to-face only because they allow invitation and presence of guest lecturers from other universities/institutions						
41.	I prefer online teaching/learning platforms to face-to-face only because they allow students to collaborate with peers in other universities and locations						
42.	The pandemic has opened the opportunity to introduce new and emerging topics such as Greencare, forest and human health, etc. to students						
43.	I had the opportunity to avoid students I have negative relationships with						
44.	I published more papers because of more time available						
45.	The use of virtual teaching tools has forced/helped teachers/professors to innovate, to learn new techniques and software's and skills as professors						
46.	I have experimented new tools and teaching approaches						
47.	Participating in academic conferences is now easier and cheaper through online platforms						
48.	The pandemic has helped students to enhance their soft skills such as collaboration, working in a team, and use of ICT tools etc.						

49. Please state other prospects that you think of that were not provided in the list above (OPTIONAL) .....

50. Which of the following activities have you explored since the beginning of the pandemic as a lecturer?*

Please choose as many options as applicable to you.
I have used videos to replace some field concepts
I have invited guest lecturers from other universities and research institutions
I have invited guest lecturers from forestry companies and organizations
I have been engaged in an inter-university collaboration of lecturers and students within my country
I have been involved in an inter-university collaboration of lecturers and students internationally
I have collaborated with more researchers outside my institution than previously
I have researched the intersection of forest and health in my research
I have explored the intersections of forest and COVID-19 in my research
Others (specify):_____

- **50b**. Others (specify):_____

51. Which of the following examination modes have you explored since the beginning of the pandemic as a lecturer?*

Please choose as many options as applicable to you.
My exams are conducted face-face
I moved my exams entirely online in an interview style
I moved my exams entirely online through structured questions on an online platform
I gave fewer or shorter exams
I have eliminated exams entirely
Nothing has changed in my examination techniques
Others (specify):_____

- **51b. Others (specify)**

Section E: Looking beyond teaching and learning forest science in COVID-19 pandemic era
Please pick the correct response to the following question based on your perception of the pandemic impact in the next 5 years.

S/N	Statements	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly disagree (1)	Not applicable (0)
52.	I feel that new jobs and career prospects will be available in the forest sector generally, e.g. Greencare						
53.	I feel that more future forestry professionals would like to work more indoor						
54.	I feel that the university has done its best to help graduates to transition to the real world of the forest profession despite the pandemic						

55.	I feel that the generation of forestry students taught during the pandemic will have better ICT and computer skills						
56.	I feel the quality of forest education delivered during the pandemic was compromised due to the shift to online teaching						
57.	I feel that the generation of forestry students taught during the pandemic will have weaker technical skills						
58.	I feel that the generation of forestry students taught during the pandemic will have weaker social and soft skills						
59.	I feel that students have acquired limited knowledge due to pandemic						
60.	I feel that new forest science graduates will not be recognized as well-prepared and qualified professionals						
61.	I feel that teaching and learning forest science in the era of the pandemic will negatively impact the ability of forestry graduates to find a job (employability) in the next 5 years						
62.	I feel that this virtual teaching of forest science will also negatively affect the way how forests are managed and will be managed						
63.	I would appreciate it if intercontinental exchange programmes could be initiated for forestry students and lecturers virtually						
64.	I would appreciate it if intercontinental exchange programmes could be initiated for forestry students and lecturers face-face						

65. Please share any other direct and short-term outcomes of the pandemic on forest education that you think of (OPTIONAL)

Please type .....
.....

66. What is the word that best describes your overall perspective of teaching forest sciences in the pandemic era?

Please type .....
.....

67. Any other comments regarding learning and teaching forestry in the COVID-19 pandemic era you would like to share or add **(OPTIONAL)** .....
.....
.....

68. Will you like to receive an abstract of the findings of this survey?

Yes
No

- **b. If yes, kindly provide your email address (OPTIONAL)**

69. Will you like to be invited to a focus group discussion for 1 hour on Zoom?

Yes

No

- b. If yes, kindly provide your email address **(OPTIONAL)**

Section F: Background information and demographic characteristics of respondents

70. Which continent is your university located?

Please select one

Africa

Europe

71. Country

Italy

Kenya

Uganda

Nigeria

Spain

72. Select your university name

Federal University of Technology Akure

Kenyatta University

Maasai Mara University

Makerere University

Ndejje University

University of Eldoret

University of Florence

University of Ibadan

University of Ilorin

University of Lleida

University of Maiduguri

University of Padova

University of Tuscia

University of Valladolid

73. Age

Less than 18 years

18 – 24 years

25 – 34 years

35 – 44 years

45 – 54 years

55 – 64 years

65 and above

74. Gender

Male

Female
I prefer not to say

75. Nationality of the respondent

Your country of origin

76. Current academic position/title

Please type your current academic position/title

_____

77. Years of academic teaching experience

Type the number

Section B: Email communications

Below are samples of the emails sent to lecturers and students before, during and after the data collection.

Annex 3: Introduction email sent to selected universities

Email subject: Request for a survey on the impacts of the COVID-19 pandemic on teaching and learning forest science

Dear Professor XXX and department administrator,
cc: Prof. Laura Secco and Assoc. Prof. Babalola Folaranmi (Thesis supervisors)

My name is Alex B. Onatunji. I am an MSc. student in the Erasmus Mundus Master Programme in Mediterranean Forestry and Natural Resources Management (MEDfOR), University of Padova, Italy. I am researching my Master's thesis on the **"Impacts of COVID-19 Pandemic on teaching and learning Forest Science in Africa and Europe: Lessons learned from case studies".**

A bit about me, I had not wanted to study for a forestry degree in my country Nigeria until I was admitted into the programme in 2014. I soon found out that most other students in my department face similar challenges and thus impacting our studies' motivation and career perspective. I eventually carried out my Bachelor's thesis on the choice of forestry degree by students in two universities in Nigeria in 2018. Since then, many good things have happened. Most recently, I am the lead author of a book on "Building a Successful Forestry Career in Africa: Inspirational Stories and Opportunities", published by IUFRO in 2021.

You will agree that teaching and learning forest science have not been the same since the beginning of the COVID-19 pandemic. Thus, in this Master's thesis study, I will be researching the experience and perspective of university forestry students (Bachelor, Master, and PhD) and lecturers on how the COVID-19 pandemic affects teaching and learning forest science. I will be conducting this study via an online survey in selected universities across Africa and Europe.

I have selected University of Padova, Italy as one of the study areas based on its experience in teaching forest science and its pivotal role in developing the upcoming generation of forestry professionals of local, national, and international impacts.

I hereby seek your support in the following areas.

1. **Permission to include your university in this study:** The reports will not identify any university name in any of the responses, thus keeping the anonymity of the survey.
2. **Sharing of the survey link** to forestry students and lecturers and helping to encourage them to respond to the survey. I will send a draft advertisement email.
3. **If GDPR rules allow you, can you share your students' and staff email contacts with me?** I promise to use it for research purposes only and will send only three emails throughout the research period.

Thank you for your time, and I look forward to your response so that I can finalize the customization of my survey and administer it.

Kind regards,

Alex Bimbo Onatunji
alexbimbo.onatunji@studenti.unipd.it
+2348102394713

Annex 4: Reconnaissance survey email sent to lecturers and students

Email subject: Reconnaissance survey: Impacts of the COVID-19 pandemic on teaching and learning forest science

Dear Prof./Dr. XXX,

My name is Alex B. Onatunji. I am an MSc. student in the Erasmus Mundus Master Programme in Mediterranean Forestry and Natural Resources Management (MEDfOR), University of Padova, Italy. I am researching my Master's thesis on the **"Impacts of COVID-19 Pandemic on teaching and learning Forest Science in Africa and Europe: Lessons learned from case studies".**

In this Master's thesis study, I will be researching the experience and perspective of university forestry students (Bachelor, Master, and PhD) and lecturers on how the COVID-19 pandemic affects teaching and learning forest science. I will be conducting this study via an online survey in selected universities across Africa and Europe.

I would like to seek your support to pilot-test running my questionnaire before I administer it to the entire sample population. I would be glad if you could help fill the questionnaire and provide the following information to me via email.

1. How long did it take you to fill in the survey (minutes)?
2. Are the questions clear and understandable enough? If there is anything unclear – please kindly point my attention to it.
3. Is the platform easy to navigate for you as a respondent?
4. Any other points for improvement.

I will be glad if you can fill in the survey and respond to this email by Friday June 10, 2022.

Here is the survey test link: https://ee.kobotoolbox.org/single/Z7hXZ1zk

Thank you,

Kind regards,

Alex Bimbo Onatunji
alexbimbo.onatunji@studenti.unipd.it
+2348102394713

Annex 5: Email communications used to advertise the survey

Email subject: Survey: Impacts of the COVID-19 pandemic on teaching and learning forest science

Dear Professors/Students XXX

My name is Alex B. Onatunji. I am an MSc. student in the Erasmus Mundus Master Programme in Mediterranean Forestry and Natural Resources Management (MEDfOR), University of Padova, Italy. I am researching my Master's thesis on the "Impacts of COVID-19 Pandemic on teaching and learning Forest Science in Africa and Europe: Lessons learned from case studies".

In this Master's thesis study, I am researching the experience and perspective of university forestry students (Bachelor's, Master's, and PhD) and lecturers on how the COVID-19 pandemic affects teaching and learning forest science. I will be conducting this study via an online survey in selected universities across Africa and Europe.

I want to seek your support to fill out my questionnaire and share it with forestry students and lecturers at the XXX (name) University, XXX (country). The survey should take between 15 – 30 minutes to complete the survey.

Data collected is anonymous. Responses will be analyzed and compared with those of your colleagues from the selected countries. All forestry lecturers (irrespective of position) and students – including Bachelor's, Master's, and PhD ones – from your university chosen can participate in this survey.

Here is the survey link: https://bit.ly/covidandforest Deadline: **July 5, 2022**.

Privacy notice: Data collected through this survey will be treated confidentially and anonymously, elaborated, and used in aggregated forms, exclusively for my thesis research purposes, complying with the General Data Protection Regulation (GDPR), Regulation (EU) 2016/679 as well as with the new "Code for the Integrity of the Research" approved by the University of Padova on the 14.09.2021.

Kindly find attached flyers that can be shared with students and lecturers in your university.

Thank you for your cooperation and contribution to this important research.

Kind regards,

Alex Bimbo Onatunji
alexbimbo.onatunji@studenti.unipd.it
+2348102394713

Annex 6: Supplementary information and data

This section shows the information and results that were not presented in the results section are presented here for better understanding and for future references.

Table 18: List of universities that offer forestry degrees in selected countries in Africa and Europe

S/N	Continent	Country	University	Year of university establishment
1	Africa	Nigeria	University of Ibadan, Ibadan	1948
2	Africa	Nigeria	Ahmadu Bello University, Zaria	1962
3	Africa	Nigeria	Bayero University Kano, Kano	1962
4	Africa	Nigeria	University of Benin, Benin	1970
5	Africa	Nigeria	University of Calabar, Calabar	1975
6	Africa	Nigeria	University of Ilorin, Ilorin	1975
7	Africa	Nigeria	University of Maiduguri, Maiduguri	1975
8	Africa	Nigeria	University of Port Harcourt, PortHarcourt	1975
9	Africa	Nigeria	Usmanu Danfodiyo University, Sokoto	1975
10	Africa	Nigeria	Federal University of Technology Owerri	1980
11	Africa	Nigeria	Rivers State University of Science and Technology, Port Harcourt	1980
12	Africa	Nigeria	Federal University of Technology Akure	1981
13	Africa	Nigeria	Imo State University	1981
14	Africa	Nigeria	Modibbo Adama University of Technology, Yola	1981
15	Africa	Nigeria	Ekiti State University, Ado Ekiti	1982
16	Africa	Nigeria	Olabisi Onabanjo University, Ago -Iwoye	1982
17	Africa	Nigeria	Federal University of Agriculture Abeokuta	1988
18	Africa	Nigeria	University of Agriculture Makurdi, Benue	1988
19	Africa	Nigeria	Nnamdi Azikwe University, Akwa	1991
20	Africa	Nigeria	University of Uyo, Uyo	1991
21	Africa	Nigeria	Delta State University, Asaba Campus	1992
22	Africa	Nigeria	Michael Okpara University of Agriculture Umudike, Umudike	1992
23	Africa	Nigeria	Adekunle Ajasin University	1999
24	Africa	Nigeria	Chukwuemeka Odumegwu Ojukwu University	2000
25	Africa	Nigeria	Kano State University of Science and Technology, Wudil	2000
26	Africa	Nigeria	Bowen University, Iwo	2001
27	Africa	Nigeria	Nasarawa State University Keffi	2001
28	Africa	Nigeria	Benson Idahosa University	2002
29	Africa	Nigeria	Cross River University of Technology	2002
30	Africa	Nigeria	Ibrahim Badamasi Babangida University	2005
31	Africa	Nigeria	Kebbi State University of Science and Technology, Kebbi	2006
32	Africa	Nigeria	Ondo State University of Science and Technology	2008
33	Africa	Nigeria	Alex Ekwueme Federal University, Ndufu-Alike	2011
34	Africa	Nigeria	Federal University Dutse, Dutse	2011
35	Africa	Nigeria	Federal University Dutsin-ma, Dutsin-ma	2011
36	Africa	Nigeria	Federal University Kashere, Gombe	2011
37	Africa	Nigeria	Federal University Lafia, Nasarawa	2011
38	Africa	Nigeria	Federal University Otuoke, Bayelsa	2011
39	Africa	Nigeria	Federal University Oye-Ekiti, Ekiti	2011
40	Africa	Nigeria	Federal University Wukari, Wukari	2011

41	Africa	Nigeria	Federal University Gashua, Gashua	2013
42	Africa	Uganda	Makerere University Kampala	1922
43	Africa	Uganda	Ndejje University, Luwero	1992
44	Europe	Italy	University of Padua	1222
45	Europe	Italy	University of Florence	1321
46	Europe	Italy	University of Torino	1404
47	Europe	Italy	University of Sassari	1562
48	Europe	Italy	University of Palermo	1806
49	Europe	Italy	University of Milan	1924
50	Europe	Italy	University of Reggio Calabria	1968
51	Europe	Italy	University of Ancona	1969
52	Europe	Italy	University of Tuscia	1979
53	Europe	Italy	University of Basilicata	1982
54	Europe	Italy	University of Molise	1982
55	Europe	Spain	Universidad de Valladolid (Palencia)	1241
56	Europe	Spain	University of Lleida	1297
57	Europe	Spain	Universidad de Santiago de Compostela	1495
58	Europe	Spain	Universidad de Oviedo	1608
59	Europe	Spain	Polytechnic University of Valencia	1968
60	Europe	Spain	Technical University of Madrid	1971
61	Europe	Spain	University of Córdoba	1972
62	Europe	Spain	Universidad de Extremadura (Plasencia)	1973
63	Europe	Spain	Universidad de León (Ponferrada)	1979
64	Europe	Spain	Universidad de Vigo	1990
65	Europe	Spain	Universidad de Huelva	1993
66	Europe	Spain	Universidad Católica de Ávila	1996

Source: Authors' research.

Table 19: Were online/virtual teaching adopted in all the courses of your forest science programme (all levels)?

	Africa		Europe		Grand total	
Use of virtual teaching	**n**	**%**	**n**	**%**	**n**	**%**
Students (n = 215)						
No	83	46.11	5	14.29	88	40.93
Yes, before and during pandemic	21	11.67	6	17.14	27	12.56
Yes, before pandemic only	3	1.67		0.00	3	1.40
Yes, during pandemic only	73	40.56	24	68.57	97	45.12
Total	**180**	**100.00**	**35**	**100.00**	**215**	**100.00**
Lecturers (n = 23)						
No	1	8.33	0	0.00	1	4.35
Yes, before and during pandemic	0	0.00	0	0.00	0	0.00
Yes, before and during pandemic	1	8.33	2	18.18	3	13.04
Yes, during pandemic only	10	83.33	9	81.82	19	82.61
Total	**12**	**100.00**	**11**	**100.00**	**23**	**100.00**

Source: Data analysis

Table 20: Which of the following options were available for students to attend lectures before and during the pandemic?*

S/N		BDP				BPO				DPO				N/A				Total				Grand Total	
		AU		EU		AU		EU		AU		EU		AU		EU		AU		EU			
		f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%
	A full degree programme can be taught entirely online																						
	Student	21	21.6	5	16.7	5	5.2	0	0.0	28	28.9	17	56.7	43	44.3	8	26.7	97	100.0	30	100.0	127	100.0
1	**Lecturer**	1	9.1	1	9.1	1	9.1	0	0.0	3	27.3	4	36.4	6	54.5	6	54.5	11	100.0	11	100.0	22	100.0
	In-person (face to face) only																						
	Student	31	32.0	7	23.3	45	46.4	17	56.7	6	6.2	3	10.0	15	15.5	3	10.0	97	100.0	30	100.0	127	100.0
2	**Lecturer**	2	18.2	0	0.0	3	27.3	6	54.5	3	27.3	1	9.1	3	27.3	4	36.4	11	100.0	11	100.0	22	100.0
	Online - synchronous																						
	Student	17	17.5	10	33.3	13	13.4	0	0.0	34	35.1	15	50.0	33	34.0	5	16.7	97	100.0	30	100.0	127	100.0
3	**Lecturer**	0	0.0	1	9.1	0	0.0	0	0.0	6	54.5	8	72.7	5	45.5	2	18.2	11	100.0	11	100.0	22	100.0
	Online - asynchronous																						
	Student	9	9.3	5	16.7	11	11.3	1	3.3	27	27.8	10	33.3	50	51.5	14	46.7	97	100.0	30	100.0	127	100.0
4	**Lecturer**	0	0.0	4	36.4	0	0.0	0	0.0	6	54.5	4	36.4	5	45.5	3	27.3	11	100.0	11	100.0	22	100.0
	Partial synchronous and partial asynchronous																						
	Student	9	9.3	8	26.7	15	15.5	2	6.7	28	28.9	11	36.7	45	46.4	9	30.0	97	100.0	30	100.0	127	100.0
5	**Lecturer**	0	0.0	2	18.2	0	0.0	0	0.0	5	45.5	4	36.4	6	54.5	5	45.5	11	100.0	11	100.0	22	100.0
	Hybrid for all – lecturer can teach students in a classroom via videoconferencing.																						
	Student	22	22.7	8	26.7	11	11.3	1	3.3	25	25.8	20	66.7	39	40.2	1	3.3	97	100.0	30	100.0	127	100.0
6	**Lecturer**	2	18.2	1	9.1	0	0.0	0	0.0	5	45.5	6	54.5	4	36.4	4	36.4	11	100.0	11	100.0	22	100.0
7	Hybrid – students can choose to attend lectures																						

	online or face-to-face in class																						
	Student	23	23.7	7	23.3	14	14.4	1	3.3	16	16.5	19	63.3	44	45.4	3	10.0	97	100.0	30	100.0	127	100.0
	Lecturer	1	9.1	0	0.0	0	0.0	0	0.0	6	54.5	6	54.5	4	36.4	5	45.5	11	100.0	11	100.0	22	100.0
	Others (specify)																						
	Student	8	8.2	1	3.3	5	5.2	0	0.0	4	4.1	1	3.3	80	82.5	28	93.3	97	100.0	30	100.0	127	100.0
8	**Lecturer**	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	11	100.0	11	100.0	11	100.0	11	100.0	22	100.0

NB: Before and during pandemic (BDP), Before pandemic only (BPO), During pandemic only (DPO), and Not applicable (N/A).

Source: Data analysis

Table 21: Which policies regarding teaching forest science online have been adopted by your university before and during the pandemic? (n=22)

S/N	Question 3	BPO						BDP						DPO						NA						GT	
		AU		EU		ST		AU		EU		ST		AU		EU		ST		AU		EU		ST			
		n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
1.	A full degree programme can be taught entirely online	0	0.0	0	0.0	0	0.0	1	4.6	0	0.0	1	4.6	4	18.2	8	36.4	12	54.5	6	27.3	3	13.6	9	40.9	22	100.0
2.	A course or module can be taught entirely online (100%)	1	4.5	0	0.0	1	4.5	1	4.6	1	4.6	2	9.1	4	18.2	8	36.4	12	54.5	5	22.7	2	9.1	7	31.8	22	100.0
3.	50% of a course or module can be taught online	0	0.0	1	4.5	1	4.5	0	0.0	2	9.1	2	9.1	5	22.7	3	13.6	8	36.4	6	27.3	5	22.7	11	50.0	22	100.0
4.	25% of a course or module can be taught online	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	4	18.2	3	13.6	7	31.8	7	31.8	8	36.4	15	68.2	22	100.0
5.	Less than 25% of a course or module can be taught online	1	4.5	1	4.5	2	9.1	0	0.0	0	0.0	0	0.0	5	22.7	2	9.1	7	31.8	5	22.7	8	36.4	13	59.1	22	100.0
6.	Others (specify)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	9.1	2	9.1	11	50.0	9	40.9	20	90.9	22	100.0

NB: Africa (AU), Europe (EU), Before pandemic only (BPO), Before and during pandemic (BDP), During pandemic only (DPO), Not applicable (NA), Percentage (%), Sub-total (ST), and Grand Total (GT).

Source: Data analysis

Table 22: Which platforms did your university use for online video lectures before and during the pandemic for forest sciences programmes?

S/N	Video-conferencing platforms	Before pandemic only				During pandemic only				Before and during pandemic				Not applicable			
		AU		EU		AU		EU		AU		EU		AU		EU	
		n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
1	Blackboard Collaborate	27	25.0	4	9.8	4	3.7	7	17.1	23	21.3	10	24.4	54	50.0	20	48.8
2	Google Meet	2	1.9	0	0.0	52	48.1	11	26.8	28	25.9	7	17.1	26	24.1	23	56.1
3	Microsoft Teams	4	3.7	1	2.4	24	22.2	8	19.5	20	18.5	4	9.8	60	55.6	28	68.3
4	Skype	4	3.7	0	0.0	8	7.4	4	9.8	12	11.1	5	12.2	84	77.8	32	78.0
5	Webex	2	1.9	1	2.4	8	7.4	5	12.2	11	10.2	5	12.2	87	80.6	30	73.2
6	YouTube (pre-recorded lectures)	11	10.2	1	2.4	25	23.1	6	14.6	18	16.7	3	7.3	54	50.0	31	75.6
7	Zoom	5	4.6	0	0.0	73	67.6	19	46.3	26	24.1	10	24.4	4	3.7	12	29.3
8	None, my university does not have such facilities	5	4.6	0	0.0	3	2.8	0	0.0	10	9.3	2	4.9	90	83.3	39	95.1
9	Others (specify)	3	2.8	0	0.0	4	3.7	0	0.0	14	13.0	1	2.4	87	80.6	40	97.6

n (AU=108, EU=41, Total=149)

Source: Data analysis

Table 23: General challenges faced by forestry students during online learning in the COVID-19 pandemic

S/N	Challenges	Strongly Agree (5)		Agree (4)		Neutral (3)		Disagree (2)		Strongly disagree (1)		Total	Mean AU	Mean EU	Mean total	Rank
		AU	EU	AU	EU	AU	EU	AU	EU	AU	EU					
1	I missed the interactions I used to have with my colleagues and lecturers before and after lectures	108	19	39	9	17	3	10	3	6	1	920	3.60	0.68	4.28	1st
2	I missed going on field trips	112	22	31	9	14	2	12	2	11	0	917	3.54	0.73	4.27	2nd
3	I missed laboratory work	84	14	45	13	25	6	15	1	11	1	859	3.33	0.67	4.00	3rd
4	I missed the positive relationships I have with my professors	61	11	48	11	39	4	16	7	16	2	789	3.08	0.59	3.67	4th
5	I had difficulties finding an internship/traineeship placement	64	8	46	12	35	9	17	2	18	4	784	3.07	0.57	3.65	5th
6	I did not have free and fast internet at home	79	3	40	7	28	5	18	10	15	10	778	3.21	0.41	3.62	6th
7	I had less access to career counselling and support services	59	7	47	11	35	10	19	2	20	5	764	3.00	0.55	3.55	7th
8	I lost access to the university computer labs	56	8	37	6	40	13	29	4	18	4	739	2.90	0.53	3.44	8th
9	I lost access to the university library resources	55	10	41	2	40	7	24	9	20	7	731	2.92	0.48	3.40	9th
10	I missed learning an important topic of interest because an entire course was cancelled due to Covid restrictions	70	7	29	5	29	6	24	8	28	9	727	2.93	0.46	3.38	10th
11	I had challenge preparing and taking examinations online	58	8	36	9	33	6	25	10	28	2	727	2.84	0.54	3.38	11th

n = 215 (AU = 180; EU = 35).

Source: Data analysis

Table 24: General challenges faced by Lecturers during online teaching in the COVID-19 pandemic

S/N	Challenges faced by Lecturers during the COVID-19 pandemic	Strongly Agree (5)		Agree (4)		Neutral (3)		Disagree (2)		Strongly disagree (1)		Total	Mean AU	Mean EU	Mean Total	Rank
		AU	EU	AU	EU	AU	EU	AU	EU	AU	EU					
1	I missed the interactions I used to have with students before and after lectures	3	7	0	1	8	3	1	0	0	0	89	3.42	4.36	3.87	1st
2	I had to stop field visits due to the pandemic	1	6	1	2	10	2	0	0	0	1	84	3.25	4.09	3.65	2nd
3	My course load and work hours were increased due to the pandemic	2	1	0	6	8	3	2	1	0	0	78	3.17	3.64	3.39	3rd
4	I published less papers because it was not possible to collect primary data for more than 2 years	2	1	0	4	8	6	2	0	0	0	77	3.17	3.55	3.35	4th
5	I had to stop laboratory research due to the lockdown	2	3	0	2	9	4	1	0	0	2	76	3.25	3.36	3.30	5th
6	I had difficulties with redesigning my academic work from face-to-face to online or mixed teaching mode	1	0	1	6	9	3	1	2	0	0	75	3.17	3.36	3.26	6th
7	I had conflict with my official work and family responsibilities	0	1	1	1	8	4	1	1	2	4	59	2.67	2.45	2.57	7th
8	I got some income constraints because one of my courses was deleted, and I got lower salary	0	0	0	0	9	3	1	1	2	7	49	2.58	1.64	2.13	8th

n = 23 (AU = 12; EU = 11).

Source: Data analysis

Table 25: Challenges experienced and communicated by the students to the universities

S/N	Experiencing and communicating challenges to the universities by the students	Not experienced						Experienced but not communicated						Experienced and communicated to the university					
		AU		EU		Total		AU		EU		Total		AU		EU		Total	
		n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
1	My studies/lab/fieldwork was delayed	64	35.56	10	28.57	74	34.42	75	41.67	17	48.57	92	42.79	41	22.78	8	22.86	49	22.79
2	I had problems with internet connection (availability, speed, reliability, etc.)	68	37.78	25	71.43	93	43.26	81	45.00	6	17.14	87	40.47	31	17.22	4	11.43	35	16.28
3	I was troubled motivating myself to attend online lectures, watch lectures videos or complete my online assignment	77	42.78	13	37.14	90	41.86	84	46.67	18	51.43	102	47.44	19	10.56	4	11.43	23	10.70
4	I experienced difficulties with online learning because it does not match my learning style	84	46.67	11	31.43	95	44.19	77	42.78	21	60.00	98	45.58	19	10.56	3	8.57	22	10.23
5	I had problems with access to a working computer	98	54.44	27	77.14	125	58.14	64	35.56	6	17.14	70	32.56	18	10.00	2	5.71	20	9.30
6	My scholarship/funding was negatively affected	126	70	27	77.14	153	71.16	38	21.11	5	14.29	43	20.00	16	8.89	3	8.57	19	8.84
7	I had difficulties with being focus and time management	70	38.89	10	28.57	80	37.21	97	53.89	21	60.00	118	54.88	13	7.22	4	11.43	17	7.91
8	I experienced loneliness or isolation because I could not have physical connections with other students/peers and/or friends/relatives	90	50	13	37.14	103	47.91	78	43.33	18	51.43	96	44.65	12	6.67	4	11.43	16	7.44
	I contracted and recovered from COVID-19 virus disease	165	91.67	20	57.14	185	86.05	11	6.11	6	17.14	17	7.91	4	2.22	9	25.71	13	6.05

n = 215 (AU = 180; and EU = 35).

Source: Data analysis

Table 26: Challenges experienced and communicated by the lecturers to the universities

S/N	Experiencing and communicating challenges to the universities by the students	Not experienced						Experienced but not communicated						Experienced and communicated to the university					
		AU		EU		Total		AU		EU		Total		AU		EU		Total	
		n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
1	I had difficulties with focus and time management	11	91.67	4	36.36	15	65.22	1	8.33	2	18.18	3	13.04	0	0	5	45.45	5	21.74
2	I experienced difficulties organizing examinations online	8	66.67	6	54.55	14	60.87	3	25	3	27.27	6	26.09	1	8.33	2	18.18	3	13.04
3	I experienced delay in my research/lab/fieldwork	7	58.33	4	36.36	11	47.83	4	33.33	6	54.55	10	43.48	1	8.33	1	9.09	2	8.70
4	I had difficulties with delivering my lectures online because it does not match my teaching style	10	83.33	4	36.36	14	60.87	2	16.67	5	45.45	7	30.43	0	0	2	18.18	2	8.70
5	I experienced loneliness or isolation with the lockdown and restrictions	8	66.67	3	27.27	11	47.83	2	16.67	8	72.73	10	43.48	2	16.67	0	0.00	2	8.70
6	I had trouble motivating my students to attend lectures, watch lecture videos or complete my online assignment	8	66.67	3	27.27	11	47.83	2	16.67	8	72.73	10	43.48	2	16.67	0	0.00	2	8.70
7	I have contracted and recovered COVID-19 virus myself	8	66.67	7	63.64	15	65.22	3	25	4	36.36	7	30.43	1	8.33	0	0.00	1	4.35
8	My research funding has been negatively affected	9	75.00	8	72.73	17	73.91	3	25	3	27.27	6	26.09	0	0	0	0.00	0	0.00

n = 23 (AU = 12; EU = 11).

Source: Data analysis

Table 27: Students perception on prospects of learning of forest science online

S/N	Prospects of online learning	Not applicable (0)		Strongly disagree (1)		Disagree (2)		Neutral (3)		Agree (4)		Strongly Agree (5)		Mean AU	Mean EU	Mean total	Rank
		AU	EU	AU	EU	AU	EU	AU	EU	AU	EU	AU	EU				
1	The pandemic has helped students to enhance their soft skills such as collaboration, working in a team, and use of ICT tools etc.	5		5	5	11	8	18	4	57	8	84	10	4.05	3.29	3.93	1st
2	I have opportunity to combine studies and work	5	5	7	4	16	8	14	5	65	10	73	3	3.92	2.57	3.70	2nd
3	I have opportunity to be engaged in more extra-curricular activities e.g., voluntary activities	6	1	6	8	11	9	23	11	71	1	63	5	3.87	2.51	3.65	3rd
4	The pandemic has opened the opportunity to introduce new and emerging topics such as Greencare, forest, and human health, etc. to students	8	0	11	4	18	3	24	8	56	8	63	12	3.66	3.60	3.65	3rd
5	I now have flexible studying hours due to online teaching methods	16	0	10	3	28	5	34	9	58	13	34	5	3.17	3.34	3.20	5th
6	I prefer online teaching/learning platforms to face-to-face only because they allow us as students to collaborate with peers in other universities and locations	16	0	34	6	35	9	30	6	40	10	25	4	2.66	2.91	2.70	6th
7	I had the opportunity to avoid professors I have negative relationships with	18	6	24	5	33	9	37	9	38	5	30	1	2.79	2.14	2.69	7th
8	I prefer online teaching method and use of video conferencing tools in compared to face-to-face only because they allow invitation and presence of guest lecturers from other universities/institutions	19	0	27	9	45	8	30	6	28	5	31	7	2.63	2.80	2.66	8th
9	I prefer Virtual Reality (VR)/ online teaching to replace some fieldwork	9	1	49	18	45	7	21	8	25	1	31	0	2.54	1.71	2.40	9th

n = 215 (AU = 180; and EU = 35).

Source: Data analysis

Table 28: Lecturers perception on prospects of teaching of forest science online

S/N	Prospects	Not applicable (0)		Strongly disagree (1)		Disagree (2)		Neutral (3)		Agree (4)		Strongly Agree (5)		Africa				Europe				Grand Total			
		AU	EU	AU	EU	AU	EU	AU	EU	AU	EU	AU	EU	F	L	M	R	F	L	M	R	F	L	M	R
1.	I have experimented new tools and teaching approaches	8	1	0	0	0	0	0	1	2	8	2	1	4	18	4.50	3rd	10	40	4.00	1st	14	58	4.14	1st
2.	The use of virtual teaching tools has forced/helped teachers/professors to innovate, to learn new techniques and software and skills as professors	8	1	0	0	0	1	0	2	2	5	2	2	4	18	4.50	3rd	10	38	3.80	2nd	14	56	4.00	2nd
3.	Participating in academic conferences is now easier and cheaper through online platforms	8	2	0	2	0	0	0	2	2	2	2	3	4	18	4.50	3rd	9	31	3.44	3rd	13	49	3.77	3rd
4.	The pandemic has helped students to enhance their soft skills such as collaboration, working in a team, and use of ICT tools etc.	8	2	0	2	0	0	0	2	1	4	3	1	4	19	4.75	2nd	9	29	3.22	4th	13	48	3.69	4th
5.	The pandemic has opened the opportunity to introduce new and emerging topics such as Greencare, forest and human health, etc. to students	8	2	0	2	0	3	0	3	0	0	4	1	4	20	5.00	1st	9	22	2.44	6th	13	42	3.23	5th
6.	I now have flexible working hours due to online teaching methods	8	2	2	1	0	2	0	5	2	1	0	0	4	10	2.50	7th	9	24	2.67	5th	13	34	2.62	6th
7.	I prefer online teaching/learning platforms to face-to-face only because they allow students to collaborate with peers in other universities and locations	8	1	1	3	0	4	2	3	1	0	0	0	4	11	2.75	6th	10	20	2.00	7th	14	31	2.21	7th
8.	I published more papers because of more time available	8	1	1	5	1	2	1	2	1	1	0	0	4	10	2.50	7th	10	19	1.90	8th	14	29	2.07	8th
9.	I prefer online teaching method and use of video conferencing tools in compared to face-to-face only because they allow invitation and presence of guest lecturers from other universities/institutions	8	1	1	4	2	4	1	1	0	1	0	0	4	8	2.00	9th	10	19	1.90	8th	14	27	1.93	9th
10.	I prefer Virtual Reality (VR)/ online teaching to replace some fieldwork	8	1	3	7	1	0	0	3	0	0	0	0	4	5	1.25	10th	10	16	1.60	11th	14	21	1.50	10th
11.	I had the opportunity to avoid students I have negative relationships with	10	3	2	5	0	1	0	2	0	0	0	0	2	2	1.00	11th	8	13	1.63	10th	10	15	1.50	10th

NB: f (frequency); L (Likert value); M (Mean value); R (Rank). PS: The frequency in the "Not applicable" option was not used to calculate the Likert mean value. The original intention of the "Not applicable" option is for lecturers who have not experienced an item and are unable to rank them. For example, a lecturer who has not used Virtual Reality (VR) in their class may not be able to give a comment or ranking about it.

Source: Data analysis

Table 29: Looking beyond teaching and learning forest science in COVID-19 pandemic era on a 5-point Likert scale

S/N	Looking beyond teaching and learning forest science in COVID-19 pandemic era	Strongly disagree (1)		Disagree (2)		Neutral (3)		Agree (4)		Strongly Agree (5)		AU Mean	EU Mean	Total mean	Rank
		AU	EU	AU	EU	AU	EU	AU	EU	AU	EU				
1	I would appreciate it if intercontinental exchange programmes could be initiated for forestry students and lecturers face-face	8	1	5	0	36	12	49	15	94	18	4.13	4.07	**4.11**	**1st**
2	I feel that new jobs and career prospects will be available in the forest sector generally, e.g. Greencare	2	2	3	5	33	18	61	14	93	7	4.25	3.41	**4.09**	**2nd**
3	I would appreciate it if intercontinental exchange programmes could be initiated for forestry students and lecturers virtually	8	1	17	5	32	18	65	9	70	13	3.90	3.61	**3.84**	**3rd**
4	I feel that the generation of forestry students taught during the pandemic will have better ICT and computer skills	10	0	17	7	41	12	60	18	64	9	3.79	3.63	3.76	4th
5	I feel the quality of forest education delivered during the pandemic was compromised due to the shift to online teaching	9	3	17	2	58	14	46	16	62	11	3.70	3.65	3.69	5th
6	I feel that the university has done its best to help graduates to transition to the real world of the forest profession despite the pandemic	15	5	13	3	53	13	58	15	53	10	3.63	3.48	3.60	6th
7	I feel that students have acquired limited knowledge due to pandemic	11	4	22	12	49	9	51	13	59	8	3.65	3.20	3.56	7th
8	I feel that the generation of forestry students taught during the pandemic will have weaker technical skills	10	7	32	9	45	7	46	16	59	7	3.58	3.15	3.50	8th
9	I feel that this virtual teaching of forest science will also negatively affect the way how forests are managed and will be managed	12	4	34	10	53	17	47	9	46	6	3.42	3.07	3.35	9th
10	I feel that more future forestry professionals would like to work more indoor	16	5	29	13	54	14	50	8	43	6	3.39	2.93	3.30	10th
11	I feel that the generation of forestry students taught during the pandemic will have weaker social and soft skills	22	6	37	6	49	12	33	14	51	8	3.28	3.26	3.28	11th
12	I feel that new forest science graduates will not be recognized as well-prepared and qualified professionals	19	4	42	13	54	14	39	9	38	6	3.18	3.00	3.15	12th
13	I feel that teaching and learning forest science in the era of the pandemic will negatively impact the ability of forestry graduates to find a job (employability) in the next 5 years	24	5	48	13	60	18	27	6	33	4	2.98	2.80	2.95	13th

n = 238 (AU = 192; and EU = 46).

Source: Data analysis