CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE
Faculty of Tropical Agrisciences
Department of Sustainable Technologies

Pro-environmental Awareness and Behaviour of Nigerian University Students

DOCTORAL THESIS

Author: Ing. Loveth Daisy Aikowe
Supervisor: Ing. Jana Mazancová, Ph.D.

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DECLARATION

I hereby declare that I have elaborated the doctoral dissertation thesis entitled “Pro-environmental Awareness and Behaviour of Nigerian University Students" independently, albeit the help of expert consultations, hence all texts in this thesis are original. In addition, all the sources have been quoted and acknowledged by means of complete references.

Prague, May 2022

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Ing. Loveth Daisy Aikowe

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List of Abbreviations

ASK Assessment of Students' Knowledge

AT Attitude towards plastic sorting intentions

CSAF Campus Sustainability Assessment Frameworks

DCI Declarations, Charters and Incentives

EA Environmental Awareness

ESD Education for Sustainable Development

FUNAAB Federal University of Agriculture, Abeokuta, Nigeria

HEI Higher Education Institution

HESA Higher Education Sustainability Act

HOC Head of Class

INGSA International Network for Government Science Advice

JAMB Joint Admissions and Matriculation Board

PBC Perceived Behavioural Control towards plastic sorting intentions

PEB Pro environmental Behaviour

PRME Principles for Responsible Management Education

SCIP Sustainability Cultural Indicators Program

SD Sustainable Development

SDG Sustainable Development Goals

SLA Sustainability Livelihood Approaches

SLT Sustainability Literacy Test

STAUNCH Sustainable Tool for Assessing Universities' Curricula Holistically

SN Subjective Norms towards plastic sorting intentions

TPB Theory of Planned Behaviour

UI University of Ibadan, Ibadan, Nigeria

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ABSTRACT

This thesis seeks to address the issue of environmental literacy and pro-environmental behaviours of Nigerian university students based on two articles recently published by author. Through a focus on plastic waste sorting intentions and an assessment of sustainability knowledge, pro-environmental awareness and behaviour of Nigerian university students is examined. The Theory of Planned Behaviour (TPB) is adapted in evaluating the determinants of plastic waste sorting intentions among Nigerian university students, while Sustainability Literacy Test (SLT) is used to assess the environmental awareness of these students. A total of 939 undergraduates (in environmental, engineering, and agriculture study programs) from the Federal University of Abeokuta and the University of Ibadan were administered a survey questionnaire, however, 650 respondents were selected to take part in the SLT assessment portion of the study. Findings of structural equation modelling depict that *perceived behavioural control* had the highest impact on the respondents' plastic waste sorting intentions, followed by *subjective norms*; however, *attitude* was found to be insignificant. The study also finds Nigerian students to have performed rather poorly on the SLT assessment. Furthermore, agriculture students exhibited higher knowledge in the social and overall sustainability topics, followed by students in the environmental study field. Recommendations suggested to current and prospective policymakers in HEIs include the relevance of introducing waste sorting management practices such as waste sorting bins within university premises. In addition, HEIs in Nigeria and other universities globally should take advantage of available sustainability assessment tools to promote pro-environmental awareness amongst young people.

1. Introduction

While several prior studies have correlated education and environmental behaviours, very little has been reported on the importance of environmental awareness and pro-environmental behaviours (PEB) in developing countries, especially among young people, as most previous studies have mainly focused on developed countries.

Additionally, it is still unclear if general formal education has a causal implication on PEB hence the necessity for a more targeted study utilizing the framework of assessing environmental knowledge through the administration of a Sustainability Literacy Test (SLT).

Furthermore, another literature gap tied to developing countries is the limited understanding of the determinants that can lead to pro-environmental behaviours, especially among young people. Hence, it is well-founded to investigate university students in developing regions, as they will ultimately possess a key influence on the future state of their immediate environment, and some may go on to make positive environmental changes globally. Therefore, it is logical to ensure wheels in motion to produce pro-environmentally inclined graduates are successful.

It is then crucial to ensure that future leaders and policy makers, recognized today as youths are equipped with knowledge and awareness of the benefits of sustainable development and how it may be achieved at various levels. This will allow elite youths who will go on to lead the country in the future, have a foundation of sustainable growth embedded within an innovative mind-set. Thus, proving useful in making better decisions for the prosperity of the country and mitigate climate change impacts.

The topical nature of climate change has allowed it to become foremost in many nations' national strategy plan worldwide. Furthermore, countries have taken steps to mitigate the challenges accompanied with climate change.

Many countries have also included awareness programs at several levels and sectors to provide a platform where non-experts are informed of climate change impacts and how to adapt, also people are becoming more conscious of the dangers of infinite production and adverse environmental behaviour on the worlds natural resources and encouraged to act with sustainable development in mind.

The future generations are also being encouraged to take on more active roles in securing a sustainable future for themselves and coming generations, through education and awareness campaigns. Currently there are younger people aware of climate change than there were in previous years.

This trend in rising knowledge amongst young people is mostly attributed to education and awareness programs as a means of disseminating environmental information. However, levels and quality of education are evidently unequal in different parts of the world. It is expected that many advanced countries are better equipped to educate their younger citizens on climate and environmental topics in contrast to under-developed and developing countries.

Furthermore, emerging countries notwithstanding the environmental challenges still need to deal with other competing priorities such as economic and social development thereby focusing their attention in those areas.

While it is important for developing countries to tackle economic and social issues, it is just as important to pay close attention to environmental sustainability, as they go hand in hand to achieve sustainable development.

Several environmental enthusiasts are decidedly convinced that if a hierarchy must be placed amongst economic, social and environmental sustainability, the later should be on top of the list as without the environment, there will be no place for economic or social matters to take place, however, the environment will sustain itself on its own in the absence of the former two.

However, from a capitalist point of view the notion remains that economic and social sustainability are more significant than the environment.

This study, however, finds that the best framework disregards hierarchy and maintains that all sides of sustainability – environment, social and economic should be considered equally.

Therefore, the contribution of this study is as follows; firstly, it contributes to the limited body of literature investigating the determinants of PEB amongst Nigerian students through the application of the Theory of Planned Behaviour (TPB). Consequently, this thesis's next objective is to assess Nigerian students' knowledge and awareness (in the study programmes of agriculture, environment, and engineering) on sustainability and environmental literacy and the influence of socio-demographics to evaluate pro-environmental awareness (PEA). PEA is assessed by evaluating students' environmental literacy by applying a bespoke SLT. Therefore, the literature gap is abridged, and more light is shed on the global implications of climate change and environmental sustainability.

Findings from this study set up the basis for recommendations targeted at universities and higher education institutions to incorporate SLT into their curriculum.

The thesis is thus structured as follows: Chapter **1, 1.1** - the introductory section highlighting the research gaps, the overall study goals and the problem statement. This is followed by Chapter **2,** which entails an extensive literature review on pro-

environmental awareness and behaviour in the global and Nigerian context. This chapter also introduces the assessment model – SLT and TPB and how they are applied in the context of this study. Chapter **3** presents the methodology. Chapter **4** presents the findings and results which are discussed, and Chapter **5** concludes the thesis and provides recommendations for HEIs and other relevant stakeholders.

1.1. Problem Statement

Many young people today are faced with inherited problems from decisions made by current and past leadership especially in developing countries, for instance, severe dependency on fossil fuel for economic prosperity (Pam, 2014), lack of commitment in improving agricultural and other viable economic sectors, serious political instability and corruption that slows down progress of development and other problems largely reflected in the huge gap between the poor and rich which continues to grow.

In places like Nigeria, population growth is another issue for concern. Globally, population growth rises, adding about 1.4 billion people yearly and about 0.5 billion in Africa as concentration of growth can be seen more in developing worlds (Mason-D'Croz et al., 2019). However, Nigeria is currently the most populated country in Africa with over 220 million residents and 40% of them represented by youths. This poses a huge threat to food security for the country, one that is mostly felt by the rural poor. To face these challenges and move the country towards a more sustainable future, it is evident that several things need to happen cohesively.

Sustainable development is at the centre of events which needs to happen. However sustainable development up until recently has remained largely controversial in settling on it's the definition. To come to a consensus on what sustainable development means to different stakeholders like the environmentalist or capitalist will

be difficult, however many authors have continued to quote the Brundtland's report of sustainable development which warns against limitations to growth in the context of the world having a finite resource, which should not be used infinitely and without consideration for future generations. This concept of sustainable development is well known and appears to agree with the school of thought that projects the importance of the natural environment (WCED, 1987).

Hence this study, in defining the concept of sustainable development adopts the Brundtland definition as it emphasises the implications for future generations, if their ability to grow is further impeded and how this should be prevented (WCED, 1987).

Young people and realistically, those from advanced countries are well informed of the dangers of environmental degradation and climate change and have even become more active stakeholders through pro-environmental behaviour.

Arguably it is believed that emerging or undeveloped countries have contributed minimally to climate change and yet bear the brunt of its impact rather unequally in face of other economic and social plights. Nevertheless, stringent efforts in achieving sustainable development which means taking environmental concerns seriously and acting accordingly need to be addressed within developing countries.

Another problem faced in developing countries is the issue of migration. The motivation behind migration of highly skilled Nigerians and other citizens from developing countries to western countries can be said to be for greener pastures and better education, as it was recorded that the number of students who travelled abroad to study from Nigeria doubled more than half in size from 10,000 to 22,000 between 2000 and 2006, and this trend is only increasing (Koch, 2014).

Nigeria was ranked by the World Bank in 2011 to be 6th among the top 10 African countries with the highest number of emigrants (World Bank, 2010). Internally, there

are countless cases of rural to urban migration which has had a negative impact on rural dwellers such as regression or snail-paced rural development, loss of traditional values, decrease in agricultural productivity, increased burden on older generations as youths migrate to city and neglect farm activities (Chukwuemeka et al., 2013; Pam, 2014).

Therefore, considering all the socio-economic issues just highlighted in Nigeria, it can be said that younger people in developing or underdeveloped countries may not be so inclined to act pro-environmentally when they are faced with other pressing challenges like being gainfully employed.

Governments in developing countries are often blamed for the lack of environmental concern as they could improve young people's interest in the environment through education and awareness which is largely lacking.

Additionally, on the importance of future talents, young people in developing countries like Nigeria will have to be more environmentally aware today for a sustainable future. The importance of elite youths in transforming the future cannot be understated as they may take on decision making roles that can drive sustainable societies based on renewable energy (Halder et al., 2013).

Being environmentally aware will give individuals and societies the tools and knowledge related to climate smart practices that could improve agricultural productivity, sustainable construction and technologies.

Furthermore, climate variability also contributes to persisting rural poverty (Mason-Dcrosz et al., 2019; Hansen et al., 2018). Climate change has disrupted and is still impeding efforts in eradicating hunger especially in Africa and South Asia, also restricting income growth globally by 1% between 2010 and 2030 (Mason-Dcrosz et al., 2019).

Additionally, environmental consideration in business strategies and cleaner production is acclaimed to accrue more potential for economic growth. Environmental degradation continues to affect many rural poor in developing countries as they are largely dependent on nature's resources for their sustenance therefore encouraging good environmental practices will bridge the gap between the rich and poor significantly.

Education is one of the ways by which governments have tackled the issue of environmental awareness along-side environmental programs and laws. In Nigeria and many developing countries however, there is still a knowledge gap on climate change and environmental awareness which should be addressed. Young Nigerians should be well informed on climate change, its impacts, and their role as advocates for pro-environmental behaviour.

One of this study's goal is to uncover how much elite young Nigerians are pro-environmentally aware and the significance of the findings will determine how these groups may influence a change in the country's status towards being progressive and meet sustainable development goals. Even though university students are not the only ones capable of benefiting from knowledge or becoming leaders in the future, they are in a good position to undertake decisions towards a more sustainable world (Vicente-Molina et al., 2017).

As claimed by Halder et al. (2013), the societal benefit of young students becoming more informed on bioenergy is considerably large. In the same way, young students, or elite youths from developing countries becoming more aware pro-environmentally in climate smart technologies in several industries like agriculture or engineering, can prove to be very valuable to the society as it could improve food production and reduce hunger and poverty.

2. Literature Review

2.1. Environmental Challenges in Nigeria – A Focus on Plastic Pollution

Nigeria has been facing environmental challenges in recent years such as climate change, desertification, deforestation, and pollution. (Dumbili and Henderson, 2020). One of the most disturbing is the exponential increase of municipal solid waste (MSW) production due to rapid urbanisation (annual growth rate of above 2%) and population increase (estimated population to be more than 180 million) (Ike et al., 2018; Troschinetz and Mihelcic, 2009). Globally, a significant contributor to MSW in the last decade is plastic waste (Heidbreder et al., 2019), generated mainly from the packaging industries (Evans et al., 2020; Mwanza et al., 2018). Between the years1996-2014 approximately 4.4 million tons of plastic material have been imported into Nigeria (Babayemi et al., 2018) from other countries (Figure *1*). Furthermore, over 50% of 13 million tons of plastic produced between 2015 and 2016 in Nigeria are single-use disposable plastic products, compiling solid waste predicament (Duru et al., 2019).

Nigeria and other African countries affected by rapid population growth and poverty (Ayodele et al., 2019) are not only facing problems with massive MSW generation (Coker et al., 2016) but also MSW management daily (Ike et al., 2018; Ezeah and Roberts, 2012). In Nigeria, the situation is considerably worsened by the immense pressure placed on a nearly non-existent waste management infrastructure and the limitations of a poor waste governance structure (Dumbili and Henderson, 2020). The current prevailing applied practices include undiscerning burning and dumping of waste refuse by the roadsides or dumpsites (Ayodele et al., 2019; Kofoworola, 2007), posing severe health risks and wellness of the people and environment. A viable solution is seen in plastic recycling (Mwanza et al., 2018) and increasing public awareness and education on its benefits (Adeniran et al., 2017).

Plastic recycling is an industrial process that begins with plastic waste sorting (Shen, 2014). Therefore, this study considers gathering or sorting plastic waste as a necessary initial step to improving plastic pollution. Nonetheless, it would bring about a notable reduction in plastic waste if there are efforts to prevent the importation and production of plastic materials earlier.

Several years of prior and ongoing importation of plastic into Nigeria warrants preventive measures like a ban on plastic imports or plastic bag use at individual level be taken into consideration in plastic waste governance. This type of initiative has already been established in some African countries like Rwanda, Kenya, and Uganda. For instance, Rwanda successfully introduced a ban on plastic bags in 2008 and a similar ban implemented in Kenya, 2018. Additionally, a tax on plastic products was proposed by Uganda's government in 2010 (Behuria, 2021).

Nigeria also endeavoured to progress in this direction by passing a bill to ban plastic bag use in 2019, with a fine imposed on defectors in the amount of ₦500,000 (approx. $1200) or a 3-year jail term (Nwafor and Walker, 2020), but until now this bill has not been passed into law.

However, there have been a few reports on plastic recovery activities through plastic waste sorting in Nigeria. Even though plastic recycling policies in Nigeria are still at their infancy, it still allows for the hope that these efforts will reduce the plastic pollution burden in the country. Further findings have shown that scavengers or people of low economic standing are generally involved in plastic recovery or plastic waste sorting for minimal financial benefits (Adeyemi et al., 2001; Nzeadibe, 2009).

This study also evaluates external barriers, attitudes, and social pressure by adopting the Theory of Planned Behaviour (TPB). These factors may explain Nigerian youths' plastic waste sorting intentions in higher institutions for learning. Furthermore,

this study evaluates other influencing factors (like environmental awareness, volunteering, university level and study programme) to assess their impacts on Nigerian students' plastic waste sorting intentions. Consequently, this study aims to provide recommendations to improve plastic waste sorting behaviour in Nigeria, and other countries could adopt these recommendations.

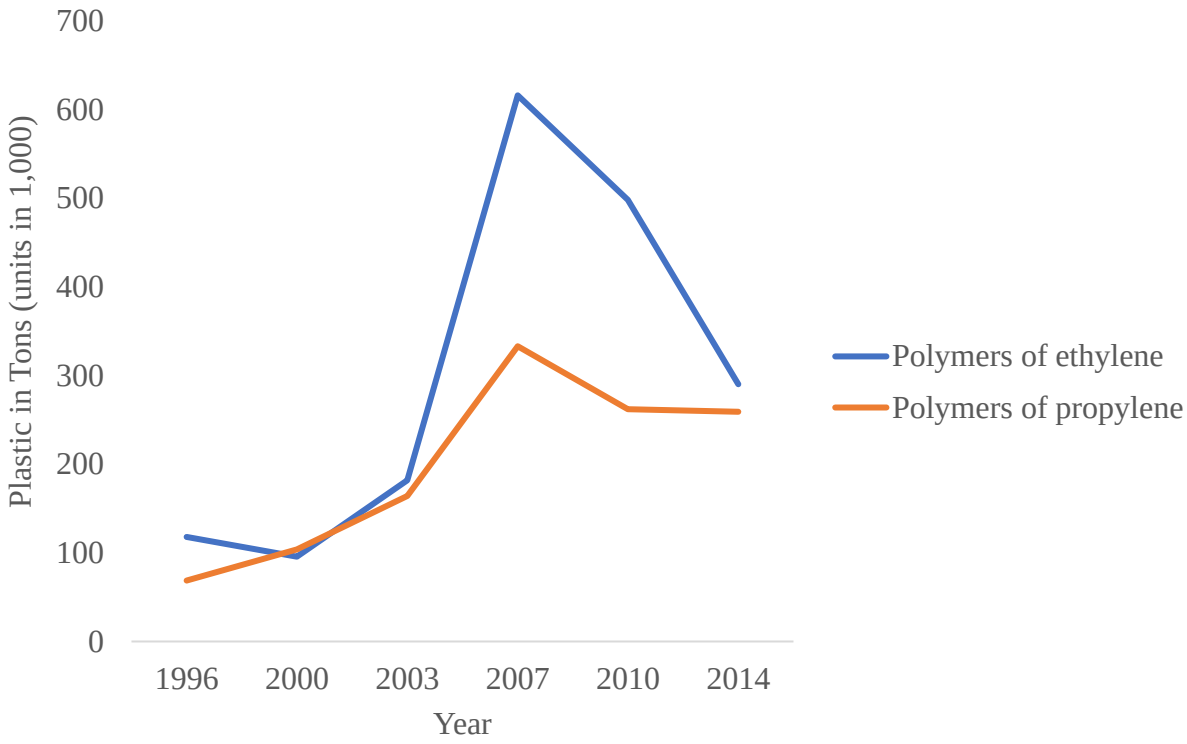

Figure 1. Plastic raw materials imported to Nigeria (1996 – 2014).

Source of data: Babayemi et al. (2018)

2.2. Hierarchal Challenges to Sustainable Development

It is well established that the world faces global challenges associated with continuous growth in population which has increased competition and insecurities of food, water, and energy especially in developing countries. This is accompanied by environmental degradation mostly borne out of anthropogenic negligence and natural phenomenon. As a result, an expanding gap in environmental sustainability, economic and social development especially in developing countries has come about.

Nizami et al. (2017) highlight some of the impacts and challenges faced by developing countries such as difficulty in achieving sustainable waste disposal mechanism due to lack of budgets, maintenance, or infrastructure. Sustainable development equally considers the three major defining components; economy, society, and environment, but the reality depicts a hierarchal preference attached to achieving any of the mentioned components.

Charfeddine et al. (2018) demonstrates this hierarchy in Qatar, in a study which aimed to provide policy makers with suggestions for conservation policies, revealing that the current procedures for managing CO_2 emissions were not economically beneficial and new conservation policies should be implemented to allow for economic growth. Charfeddine et al. (2018) also recognizes that a reduction in the rate of energy consumed may slow down economic activity, but uncontrolled energy consumptions will equally affect the environment adversely, but the policies reflected a preference to obtain economic growth.

Yildirim et al. (2015) also indicate that most students claim to have engaged in pro-environmental behaviours, however these pro-environmental actions stemmed from internal ethical values but also could be attributed to economic benefits. Similarly, Truelove and Gillis (2018) find that PEB intentions are associated with

financial costs among non-experts. Meyer (2015) also stated that because of education, individuals are aware that taking part in certain pro-environmental behaviour can be associated with financial savings (Biasutti and Frate, 2017; Truelove and Gillis, 2018). In Slovakia, authors uncovered that university students' motivation to engage actively in the education process was linked with employability and education quality (Kucharcikova et al., 2019).

Alternately, in a study conducted in Spain by Drews and van den Bergh (2016) to conceptualize on a broad public perspective on topical discussion of economic growth and environmental sustainability which deduced a variety of differed opinions. Most correspondents agreed that 'green growth' is achievable, i.e., environmental sustainability can be achieved alongside economic growth (Drews and van den Bergh, 2016).

D'amato et al. (2017) also supports green economy where it is appraised for being more inclusive. The ideology stems from product recycling, an existing concept since the beginning of industrialization, the concept is backed by practices that supports the argument which claim that a circular economy reduces harmful environmental impacts and promotes new opportunities for businesses (Korhonen et al., 2018).

Still, there exist several barriers to achieving the notion of an infinitely productive economy like financial, operational, structural, technological, and even attitudinal barriers. These factors contribute to the impediments of achieving the circular economic reality (Ritzén and Sandström et al., 2017).

To achieve a development that meets the need of the present without compromising the needs of future generations as defined by sustainable development WCED (1987), it is necessary especially for emerging countries to move way from a linear economic model and pull toward a circular and integrative model as this will

require a more organized legislative structure and sustainable technologies. Additionally, sustainable development should be viewed as an interdisciplinary notion that combines both economic theory and natural science to create a harmonious setting in which social, economic, and environmental components can interact freely with each other (Scutaru, 2013).

2.3. Plastic Waste and Waste Governance in Nigeria

Plastic materials derived from a varied range of polymers of high molecular mass are considered a waste stream with potential for recycling and recovery (Babayemi et al., 2019). Low-density polyethylene has been majorly imported into Nigeria over the last two decades and then used to produce a wide range of plastic products (grocery bags, cling wraps, sandwich bags, bubble wrap, fertiliser sacs, refuse bags and plastic bottles). However, these are often used once and discarded (Evans et al., 2020; Mwanza et al., 2018; Babayemi et al., 2018). Additionally, polypropylene has also been used majorly in Nigeria's manufacturing industries. These materials are then applied to produce many plastic products such as butter or margarine containers, biscuit wrappers, heavy-duty bags, straws for drinking, prescription syrup bottles and plastic bottle caps (Babayemi et al., 2019).

Even though plastic is considered to have high recycling and recovery potential, the rate of recycling reported to be less than 12% in Nigeria (Babayemi et al., 2018) does not match the fast pace at which plastics are being used produced. Therefore, for MSW management to be successful, plastic recycling and recovery practices need to increase, and at the same time, production of new plastic products should decrease (Hammed et al., 2018).

Many developing countries like Nigeria are still struggling to reform and overcome barriers to waste management issues (Ayodele et al., 2018). According to Abd'Razack et al. (2016), one of the most critical obstacles found in Abuja and Kaduna state, preventing the reformation in sustainable waste management practice like waste sorting, is the lack of education or public awareness. In Nigeria, the national policy on plastic waste has been established to restrict unsafe plastic waste practices. The current predominant means of waste disposal among Nigerian people includes dumping refuse indiscriminately by the road or landfills (Ayodele et al., 2018). These practices have made governmental waste policies and efforts nearly futile. The policy's goals were to move Nigeria towards a more circular economy and redirect tons of plastic waste from the streets for recycling (Ezeah and Roberts, 2014). However, government alone (Akanle and Shittu 2019) should not be responsible for MSW management efforts. Still, the Nigerian public also needs to be sensitised of the consequences of improper waste management on the environment and people's health (Hammed et al., 2018).

The policy framework supporting plastic recycling is still not entirely in the government's attention (Dumbili and Henderson, 2020). It consists only of two recently approved papers - National Policy on Solid Waste Management approved by the Federal Ministry of Environment (FME) in 2018 and National Policy on Plastic Waste approved by the Federal Executive Commission (FEC) in 2020 (Igomu, 2020). Some earlier institutional reforms were held. One of the earliest reform initiatives by the Federal Government of Nigeria was in 1988 when the Federal Environmental Protection Agency (FEPA) was established to recognise the solid waste management (SWM) challenges Nigeria faces.

In 2000 FEPA became an independent Department of the Federal Ministry of Environment. This has transferred the responsibility of SWM at the federal level to be overseen by the Federal Ministry of Environment, Housing and Urban Development (Ezeah and Roberts, 2014). Consequently, following the federal initiative, several states in Nigeria started establishing their own State Environmental Protection Agency (SEPA), which took place around the mid-1990s (Ezeah and Roberts, 2014). To achieve a better-structured autonomy, the National Environmental Standards and Regulations Enforcement Agency (NESREA) was established to replace the FEPA act in 2007; management designation relies on political connections rather than actual qualifications or experience. This mismanagement has extended the gap in positive output from these agencies (Duru et al., 2019). Despite these measures of creating environmental agencies, the waste management infrastructures in place are relatively poor. In many municipalities, the local government did not follow suit from the federal and state governments in their environmental initiative, which worsened the outcomes of waste governance on local or municipal levels (Ezeah and Roberts, 2014).

2.4. A Global Perspective on Waste Sorting Practices at Universities

Generally, universities could be described as quasi cities because they usually cover a vast territory and contain different selections of individuals, impacting the environment on different levels and being looked to as change drivers (Adeniran et al., 2017). Several waste management efforts are being carried out in universities from other parts of the world. At Shenyang University in China, Geng et al. (2016) reported SWM initiatives like replacing old nonseparation bins with new bins that distinctively indicated signs for recyclables and non-recyclables, integration of the projects on polyethylene separation and environmental lectures. Another study conducted at the University of Florence, Italy, revealed sustainable waste practices like plastic and paper recycling, which is indicated as one of the projects focused on campus (Fissi et al., 2021). Furthermore, Dagiliūtė et al. (2018) also found in a green Lithuanian university that one of their internal sustainability practices within the campus included waste sorting, which the students encouraged and practised.

However, some universities in Nigeria are showing positive strides regarding zero waste initiatives. Adeniran et al. (2017), in the characterisation of solid waste studies, reported that the University of Lagos has zero waste strategies to limit the creation of waste and provides incentives and recycling bags at low cost to residents on the university campus.

Waste sorting bins already exist minimally in Lagos city; however, there is a need for more sophisticated waste disposal methods in Nigeria, especially waste sorting at the waste source (Dumbili and Henderson, 2020). This emphasises the role of the government, universities, and young elites and how their status can be applied to improve public awareness and participation in plastic waste sorting and recycling goals (Dumbili and Henderson, 2020).

2.5. Environmental Awareness

To develop an environmental concern or behaviour that benefits the environment, knowing the environment is consequential for individuals. The environment was described decades ago as where living things reside (Yazici and Babalik, 2016). The environment combines air, water, sound, land, living things, including humans.

Hence, as Akkor and Gunduz (2018) defines it, the environment is an outer atmosphere where all living creatures preserve their relationships during their existence. Humans are considered the shapers of an environment (Yazici and Babalik, 2016) that consist of several factors (biological, physical, social, economic, and cultural factors) making up human surroundings. From the onset of life on earth, human nature has been tailored to acquire benefits from their surroundings to cater for their needs. However, there has been a consistent shift away from the equilibrium between natural resources available and human consumption, causing an imbalance as natural resources are being over-used and environmental problems have surfaced (Yazici and Babalik, 2016).

Among the environmental problems faced in today's world are climate change, global warming, loss of biodiversity and agricultural lands, soil degradation, rapid upsurge of human population (Yazici and Babalik, 2016), and environmental pollution (Akkor and Gunduz, 2018). To address these environmental problems, it is imperative to build a shared awareness (Kulozu, 2016; Yazici and Babalik, 2016) and a sense of accountability worldwide (Kulozu, 2016); especially in developing countries where 85% of the world's population reside (Bahaee et al., 2014), and grow daily (Kulozu, 2016).

Hence, through environmental awareness (EA), society or an individual reacts to environmental problems with environmental protection actions (Akkor and Gunduz,

2018). EA is acclaimed to be a component that countries may apply to strengthen their sustainable development (Yazici and Babalik, 2016).

A general definition of Knowledge as the oxford dictionary describes it “is the awareness or familiarity gained by experience of a fact or situation”, however these are not typically synonymous terms in quantitative social research. Environmental awareness has also been described as an essential component of environmental literacy (Zhang et al., 2017), but EA has a value component associated with competencies (Dlouha, 2022). To simplify the terminology in the context of this study, knowledge and awareness are used in this research interchangeable with the adoption of the oxford reference.

In modern society, Kulozu (2016) ironically points out that people are unlikely to have environmental knowledge or literacy as environmental problems worsen daily. Claiming that the environmentally literate are usually only knowledgeable about local or national environmental problems instead of worldwide; however, as environmental problems go beyond borders, it is argued that environmental literacy should also not be restricted to national or local levels. From another perspective, Asilsoy et al. (2017) encourage environmental literacy within the confines of an individual’s local boundaries besides environmental knowledge on a global scale. They further state that awareness of local fauna or flora and existing endemic species, allows for the potential of cultivating pro-environmental behaviours among individuals and society.

Regardless of global or local environmental literacy, getting educated on environmental issues should include all age groups through formal or informal education (UNESCO, 1978; Akkor and Gunduz, 2018). However, younger generations are the focus of several works of literature on environmental awareness (Kulozu, 2016). According to the UN (2019), the population of young people between the ages

15 – 24 years reached 1.2 billion (16%) of the world's population and is projected to rise by another 200 million in 2065. Therefore, increasing environmental literacy among young people is crucial (Yazici and Babalik, 2016; Kulozu, 2016). Ozden (2008) rightly points out environmental education ought to begin from primary school (Simsekli, 2015) through to secondary school (Altin et al., 2014; Hassan et al., 2010) all the way up to university.

Furthermore, recounting the objective of creating widespread awareness of the Tbilisi Declaration (Tbilisi+35 'International conference on environmental education for sustainable development') (Kulozu, 2016), this study recalls its objective also promoting environmental awareness to all relevant stakeholders in the education system. In so doing, the expected result is for pro-environmental behaviour to be positively impacted through an increase in more environmentally friendly actions.

There have been a number of extensive research on socioeconomic variables of pro-environmental behaviour (Meyer, 2015). Some of these studies have looked at factors such as gender (Vincente-Molina, 2015), age, marital status, education (Meyer, 2015; Vincente-Molina 2013; Torgler and Garcia-Valina (2007) and how these factors influence pro-environmental behaviour. However, this study contributes to the literature by focusing on the impact of environmental knowledge by evaluating the results of the Sustainability Literacy Test among university students.

Even though EA has been contended to have a multidimensional construct in the past (Abdul-Wahab, 2010), however, following many years of consistent improvement of related concepts, environmental awareness is considered an aspect of environmental literacy and frequently associated with pro-environmental knowledge; all these terminologies ((pro) environmental knowledge or environmental literacy) are collaborative (Fu et al., 2018) and can be used interchangeably in the context of this

study to define pro-environmental awareness (PEA). The increase in environmental knowledge will often lead to a similar rise in environmental awareness, concern, and even pro-environmental behaviours (Creech et al., 2009). In general, environmental awareness is regarded as an essential part of environmental literacy (Zhang et al., 2017).

Furthermore, environmental knowledge has been described as knowledge and awareness of environmental problems and being able to proffer likely solutions to these problems. Moreover, it is defined as the ability to identify several symbols, ideas and behaviour patterns concerning protecting the environment (Vincente-Molina, 2013). Zsoka et al. (2013) inform that environmental knowledge constitutes a viable aspect of an individual's environmental awareness, among other variables such as attitudes or intentions. If one is unaware of potential or existing environmental issues, it is unlikely to expect such individuals to behave pro-environmentally (Liu et al., 2020) knowingly. This statement is the basis of Hines et al. (1987) meta-analysis of environmentally friendly behaviour where knowledge was considered the most compelling determinant. Therefore, it is expected that environmental education to raise awareness and knowledge may impact students' pro-environmental behaviour through ways like knowledge transfer and setting social standards or examples (Zsoka et al., 2013).

However, contrary studies by Paco and Lavador (2017) claim that environmental knowledge and behaviour are not related. Additionally, Bamberg and Moser (2007) state that even though an increase in environmental knowledge may lead to a subsequent increase in environmental concern by individuals, this does not guarantee a resulting change in environmental behaviour.

2.6. Environmental Education and Pro-environmental behaviour

Many young adults today in spite environmental education still portray a lack of environmental concern (Vicente-Molina et al., 2013). Reluctance in engaging in environmental activities even at universities that practice green initiatives demonstrates the need to improve environmental concern, attitudes, and ultimately environmental behaviour amongst young adults (Vicente-Molina et al., 2013). Therefore, several literatures corroborate that environmental education should not be considered on its own in relation to environmental behaviour but should include other factors (such as environmental attitude, concern, culture, context, course, etc.) to develop better ways to improve environmentally beneficial behaviours amongst elite youths.

One of the expectations of tertiary institutions (HEIs) is taking on a front role towards bringing up tomorrow's leaders who could tackle challenges pertaining to sustainability in the context of social, environmental, and economic development (Sidiropoulos, 2018).

There are two opposing views on the relationship between environmental education and pro-environmental behaviour (Meyer, 2015). Several authors claim that environmental education sets the basis for social behaviour that would lead to sustainable practice, furthermore people that are more environmentally informed will 'know better' and act accordingly in favour of environmental management (Vicente-Molina et al., 2017; Dagiliūtė et al., 2018). However, this view is not unanimously shared.

2.6.1. Positive views on the significance of environmental education

The important role of future talents in decision making which ideally should be environmentally beneficial is noteworthy. The idea is that this will progressively move

societies towards a path of sustainability. Hence according to (Vicente-Molina et al. (2013) it is vital to find out if, not only future leaders, but also political and educational institutions are prepared to introduce necessary changes that will promote advanced level of pro-environmental behaviour and environmental knowledge in universities.

A study involving a sample of Indiana university students has further exemplified the importance of environmental education in equipping students with relevant environmental knowledge and influencing their pro-environmental behaviour (Pizmony-Levy and Ostrow-Michel, 2018). Indiana university students reported that hearing concepts such as sustainability and environmentalism in class positively influenced their levels of care for the environment. Similarly, the students reported that their pro-environmental behaviours were linked to membership in university-based environmental groups (Pizmony-Levy and Ostrow-Michel, 2018).

A strong positive association between the intensity of environmental education and students' environmental knowledge has also been established among Hungarian university students (Zsóka et al., 2013). That is, environmental education is useful in shaping students' pro-environmental attitudes as claimed by Zsóka et al. (2013). Another study of university students from Tokyo Bay and San Francisco Bay Area, Nishiyama (2014) claimed that environmental education at both childhood and university educational levels has a strong positive impact on students' environmental attitudes and pro-environmental behaviour. Similarly, Kirk (2010) reported a significant positive relationship between students' environmental knowledge and pro-environmental behaviours. Similar findings have been reported amongst Lithuanian students by Poškus (2018).

2.6.2. *Opposing views on the significance of environmental education*

On the opposing side, Dagiliūtė and Liobikien (2015) claim that, after sustainability education, there remained insignificant change in attitude of Lithuanian students towards environment issues. Similarly, with pro-environmental behaviour Fernandez-Manzanal et al. (2015); Robinson (2015) did not find any change with Spanish and UK students respectively. In addition, Heeren et al. (2015) also collaborated the same narrative as it was claimed that education does not have any significant impact on student's sustainability actions.

Moreover, Gouvea et al. (2016) reported that environmental teaching has no impact on students' pro-environmental behaviour. Students were found to show no improvements in environmental behaviours based on the number of environmental classes, thus indicating that family habits had a more significant influence on students' environmental behaviours. In support of Vicente-Molina et al. (2013) findings, He et al. (2011) reported that even though Chinese university students had low levels of environmental knowledge, they exhibited pro-environmental behaviours as manifested by their commitment to environment-friendly behaviours. However, like in Vicente-Molina et al. (2013) study, students' pro-environmental was affected by levels of regional economic development; with students from developed regions showing more pro-environmental behaviours than those of less-developed regions despite having been exposed to similar institutionalized environmental education.

Thus, it can be said that having environmental education at university may not be enough to produce graduates who behave pro-environmentally in the society. A reason for this according to Fernandez-Manzanal et al. (2015); Carmi et al. (2015) is that most training at university level may be more abstract than practical and pay more

emphasis on analysing environmental issues than providing student with tools or solutions to deal with these issues.

2.6.3. Environmental attitudes and concern

It has been claimed that differences in pro-environmental behaviour is better described through environmental attitudes and values of students than through environmental education (Carmi et al., 2015). Also, Sidiropoulos (2018) in a study focused on students' environmental inclinations by assessing the impact of sustainability education found that students self-reported sustainability actions demonstrated little commitment to such actions.

Similarly, Brazilian university students' pro-environmental behaviours have been reported to be linked to four aspects of environmental concern — apathy, anthropocentrism, connectivity, and emotional affinity (Amérigo et al., 2017). Consequently, claiming that, providing environmental education by focusing on the four attitudinal aspects can enhance pro-environmental behaviours affinity (Amérigo et al., 2017).

2.6.4. Green universities

Dagiliūtė et al. (2018) in comparing a green university against non-green university in Lithuania, revealed that the university representing itself as green have more students with environmental knowledge, however these students, even though they are very well informed with the university green initiatives do not readily participate in environmental or social activities that the university organizes.

China has also been said to promote environmentally friendly campuses over the years, but recent research still indicates a gap between awareness and behaviour, according to Fu et al. (2017), this gap can be attributed to China's core focus on eco-technology instead of publicity and broadcasting (Fu et al., 2017; Zhao and Zou, 2015).

2.6.5. Environmental consciousness over time

Additionally, authors have attributed higher level of environmental consciousness to higher educational level, and according to findings by Meyer (2016), an additional year of education increases the likelihood of environmental behaviour. Consequently, Meyer (2016) claims that education causes people to be more socially involved therefore allowing them act in a manner that is environmentally acceptable (Zareie and Navimipour, 2016). Furthermore, Liem and Martin (2015) claim that young people tend to show adaptations to environmental issues by searching for information about these issues which inherently makes them more concerned and interested in solving environmental issues. Moreover, Vicente-Molina et al. (2013) surmised that shortage or withholding knowledge will limit pro-environmental behaviour.

2.6.6. Personal identity

According to Dagiliūtė et al. (2018) universities can serve as an example to other institutions in moulding student's personality to be more oriented toward sustainability as they largely contribute to students' view of the world, values and even their personal identity. Hence as suggested by Dagiliūtė and Liobikienė (2015) a key role of universities is to cultivate willingness amongst students towards engaging proactively in environmental issues and pro-environmental behaviour in general, recommending proposing special courses to students to achieve this.

Furthermore, Dagiliūtė et al. (2018) also states that universities are relevant stakeholders in providing sustainability education especially through channels like curriculum and course plans as this enables universities actively shape students' personalities towards sustainability.

2.6.7. Mode of disseminating environmental education

Dalida et al. (2018) sought to understand whether the mode of delivery of environmental education (traditional learning versus community-based learning) affects students' pro-environmental behaviours. Findings of the study revealed that community-based environmental education is more effective in the development of pro-environmental attitudes than traditional learning approaches (Dalida et al., 2018). Consequently, it is recommended that community-based learning should not be overlooked.

Simarly, Ajaps and McLellan (2015) established that UK and Nigeria university students with environmental knowledge reported pro-environmental behaviours. Moreover, Ajaps and McLellan (2015) indicated that the students' needed environmental education content given to them through practical approaches such as field trips. As a result, the authors recommend that both theoretical and practical approaches to environmental education are crucial for promoting pro-environmental behaviours.

2.6.8. Cultural consideration

Pro-environmental behaviour has also been found to be affected by students' cultural background. For instance, Turkish students were found to have higher pro-environmental behaviours than Middle Eastern students because of their hierarchical and egalitarian cultural tendencies (Tezel et al., 2018). Similarly, Fu et al. (2017) reported that pro-environmental behaviour among Chinese students was high because of pro-environmental cultural atmosphere characterized by China's universities inclination towards eco-technology and energy management.

2.6.9. Enjoyment of nature

Another proclaimed predictor of pro-environmental behaviour reported amongst Finland students is the enjoyment of nature (Kukkonen et al., 2018). Education that allows exposure and enjoyment of nature is also said to be useful in promoting student's sensitivity and feelings to the environment (Kukkonen, et al., 2018; Braun and Dierkes, 2017). As suggested by Sidiropoulos (2018) to improve student's human-nature relationships, sustainability education ought to be integrated into all pedagogic programs. Students who enjoy nature, those who do not support human dominance, and those who possess global concerns are more likely to show pro-environmental behaviour according to Kukkonen et al. (2018).

2.6.10. Context specific

When it comes to environmental knowledge, and its impacts on pro-environmental behaviour, the effectiveness of general knowledge versus environmental-specific knowledge has intrigued researchers (Geiger et al., 2019). Findings from Geiger et al. (2019) showed that general knowledge (with an environmental domain) weakly predicted pro-environmental behaviour, unlike environmental-specific knowledge which strongly predicted positive environmental behaviours.

Additionally, in a study aimed at understanding predictors of students' pro-environmental behaviours, Onokala et al. (2018) reported that United States university students have a higher level of pro-environmental behaviour than their Chinese counterparts, showing that environmental behaviour is context specific and different predicator variables produce different significant results depending on the local environment

2.6.11. Environmental courses or related subjects

One more essential aspect of students' pro-environmental behaviour is whether or not a student is pursuing an environment-related course (Heyl et al., 2013). Dagiliūtė and Liobikienė (2015) claim that when trying to reach students who are not committed pro-environmentally, one important approach is through environmental courses. Therefore, highlighting the relevance of the type of subject or discipline, including if environmental related subjects are covered as a factor that could impact on a person's environmental knowledge. Furthermore, Dagiliūtė et al. (2018) went on to recommend that universities should still improve sustainability curriculums as their study demonstrated that students did not get enough knowledge on sustainability.

Among Chilean university students, those who pursue environment courses were found to be more likely to show a higher frequency of pro-environmental behaviours than those who do not. Furthermore, Dagiliūtė and Liobikienė (2015) findings indicated that students who were present for related environmental courses showed more environmental concern than other students, nonetheless environmental concern did not translate to keenness to take on environmental responsibilities or encourage any change in pro-environmental attitudes amongst the students.

In Malaysia, Ahmad et al. (2010) established that university students had extensive knowledge of environmental issues. However, it was concluded that the students did not have adequate knowledge of some environmental concepts and terms like biodegradability. An important finding suggested that students with a vast knowledge of environmental issues were found to have pro-environmental behaviours.

Interestingly Vicente-Molina et al. (2013) study claims to find reduction in the likelihood of increased environmental performance with an increase in number of environmental related courses as they found that science and students from

engineering department showed more likelihood for pro-environmental behaviour than students studying social sciences. This corresponds to Dagiliūtė et al. (2018) findings that engineering students and younger students were more environmentally active. Similarly, Akeel et al. (2018) reports that Nigerian Engineering community did not show high environmental knowledge.

Nonetheless, course or discipline remains an important factor as described by Sidiropoulos (2018) who noted that engineering student did not perform as well as IT, business, or accounting students for self-reported environmental behaviour.

2.6.12. Green purchasing

It is also relevant to highlight the positive role of environmental education in promoting students' pro-environmental behaviours which has been manifested through students' green purchase behaviour according to Lai and Cheng (2016). For instance, undergraduate students in Hong Kong were found to have positive environmental behaviours and environmental responsibility, as shown through their appreciation of green marketing practices and their green purchase behaviour (Lai and Cheng, 2016). Similar findings have been found in developing nations, such as Taiwan and India (Yadav and Pathak, 2016; Yu et al., 2017).

2.6.13. Role of governments and NGOs

Findings of a positive relationship between environmental knowledge and pro-environmental behaviours have important implications for government and non-governmental organizations. First, the government needs to include environmental education in the country's education curriculum (Chierrito-Arruda et al., 2018; Gündüz and Erdoğuş, 2017; Schmitz and Rocha 2018). This is because when young people are taught environmental concepts from childhood, such as pollution and climate change, they will grow knowing the value of sound environmental practices (Gouvea

et al., 2016). Consequently, young people will be expected to adopt good environmental behaviours aimed at ensuring sustainability of the environment. This stems from the concept that promote environmental education or knowledge to be positively associated with pro-environmental behaviours (Li, 2018).

Similarly, non-governmental organizations should educate the public on the importance of positive environmental behaviours or environmentally friendly values. If the public is equipped with environmental knowledge, there is a high likelihood that the public will cultivate more sustainable behaviour, such as the use of green manure and green buying behaviours (Li, 2018).

Apart from the critical role that the government and non-governmental organizations need to play in improving the public's environmental knowledge, it is also crucial for families to teach their children good environmental behaviours from childhood (Daubenmire et al., 2017).

2.7. Concept of Sustainability Education

Sustainability education is one approach to advance students' environmental literacy (Zhang et al., 2017). Education for sustainable development (ESD) involves a dynamic learning process that drives students to attain sustainable development (SD) knowledge and skills (Melles and Paixao-Barradas, 2019). Currently, there is no set way accepted regarding SD learning and teaching in higher education institutions (HEIs), hence the call for more orderly implementation and agreement on the topic of sustainable literacy (Melles and Paixao-Barradas, 2019).

HEIs have assumed a critical part in the moulding of future pioneers and has developed from outdated imperious courses of unique ideas to a more student-focused type of learning, going on to encourage the shift from the mind-set of just

pursuing a degree to developing lasting learners (Zizka and Varga, 2019). Thus, the idea of sustainability being introduced into educational programs and included in HEIs technique to shape students to become pioneers who care for their environment is being adopted by several HEIs internationally (Zizka and Varga, 2020).

Furthermore, with the latest topical importance and spotlight on the Sustainable Development Goals (SDGs), education for sustainability is necessary for implementing pedagogical activities (Melles and Paixao-Barradas, 2019). The events following the United Nations pronouncement of 2004-2015 as the Decade for Sustainable Development (Sidiropoulos, 2014) and the UN report of its Principles for Responsible Management Education (Seto-Pamies and Papaoikonomou, 2016) resulted in the United States of America's release of the Higher Education Sustainability Act (HESA) and the University for a Sustainable Future. These are recognised global activities which centre on environmental literacy and sustainability (Zizka and Varga, 2020).

Nowadays, HEIs are tasked with providing knowledge and guidance on initiatives and activities related to sustainability as they contribute immensely to the emergence of a student entering the labour force as employees, managers, business owners and leaders (Seto-Pamies and Papaoikonomou, 2016). If HEIs pay attention to their obligation, it can get ready youthful alumni who not only have faith in continuous learning (Renfors et al., 2019) but participate in their communities actively. More importantly, they can face environmental or social issues to ensure the prosperity of all around them (Deale and Barber, 2012).

According to Wi and Chang (2019), the problem found with environmental education is that individuals are only given information but not aided in understanding the provided information. Transformative learning remedies this by allowing learners

to transform information into knowledge, thereby creating additional steps or actions resulting from this new knowledge acquired (Wi and Chang, 2019). Therefore, to ensure ordinary information transcends into something meaningful, individuals must relate new ideas with existing knowledge (Wibeck, 2014). In light of these, one of the ways universities have been able to assess environmental knowledge is through a Sustainability Literacy Test (SLT). Among the objectives of an SLT is to improve sustainability literacy and allow universities, companies, or other relevant stakeholders the platform through which they can quantify and promote environmental knowledge (Decamps et al., 2017).

The concept of SLT is accompanied by numerous assessment tools readily available to be adopted by HEIs to advance sustainable development and environmental knowledge. A few examples of SLT assessment tools include curricular instruments like Sulitest® (Sulitest.org, 2021), ASK – Assessment of Sustainability Knowledge (Zwickle et al., 2014; Callewaert, 2018), STAUNCH - Sustainability Tool for Assessing Universities' Curricula Holistically, and policy instruments like the green plan, CSAF – Campus Sustainability Assessment Framework, SLA – Sustainability Livelihood Approaches, the green metric, SCIP – Sustainability Cultural Indicator's Program (Callewaert 2018; Rao et al., 2010) and college sustainability report card (Zainordin and Ismail, 2018).

Sustainability Literacy Test (SLT) is one of the options available to assess sustainability knowledge in HEIs. SLT has been conducted on the Nigerian engineering community to assess engineering students, educators, and practitioners (Akeel et al., 2019). However, there has been no other investigation on sustainability literacy utilizing the Sulitest® (Sulitest.org, 2021) or other comparative instruments administered in Nigerian universities.

2.8. Sustainability Education in Higher Education Institutions

Education has been attributed to be essential to many sustainable solutions worldwide (Wojuola and Alant, 2019). Often, young people are at the forefront of awareness initiatives as important stakeholders who hold the key to future sustainability goals (Ifegbesan, 2010). In Nigeria, 40% of its estimated 186 million residents are represented by young people within the age group 18 to 35 years (Duru et al., 2019). Still, only about 2 million of these populations are enrolled in universities (National Universities Commission, 2018).

University communities themselves are responsible for ensuring sustainable practices by educating people to manage key positions in society (Coker et al., 2016). For instance, a study by Dagiliūtė and Liobikiene (2015) considered the opportunities for sustainability in a university at Lithuania and found that environmental courses showed some potential importance in reaching students who were not normally committed to the environment.

Therefore, universities hold principal accountability in making sure young people know the significance of sustainable practices like plastic waste sorting. Universities provide these youths with the knowledge, tools and technology they can develop to promote pro-environmental behaviours within their societies (Wojuola and Alant, 2019). This study focuses on young elite Nigerians at selected university institutions as they represent vital stakeholders relevant to achieving Nigeria's plastic waste sorting goals (Akanle and Shittu, 2019).

The UN Conference on Sustainable Development in 2012 advised HEIs about the necessity of their responsibility to their students' advancement in sustainability awareness globally (UN, 2012; Mason, 2019). So far, many HEIs have claimed to be interested in implementing sustainability initiatives in their institutions. To verify these

claims made by HEIs on instilling sustainable initiatives within their organizations, the Declarations, Charters, and Incentives (DCI) have been vital instruments (Zainordin and Ismail, 2018). According to Lozano et al. (2013), DCIs are valuable guidelines for HEIs, to help implement initiatives. For over two decades, several DCIs have been authorized in different organizations worldwide (Zainordin and Ismail, 2018). Table 1 summarises some DCIs that have taken effect over the last decade, as reported in Higher Education and Research for Sustainable Development (HESD, 2021).

As a result of the ideas below and more from prior years not summarized in the below table (Zainordin and Ismail, 2018; Lozano et al., 2013), it shows that through global initiatives, interest in sustainability goals in HEIs continuously evolves (Lozano et al., 2015; UN, 2012). Furthermore, HEIs have become more prominent as a source by which a resilient environment is enabled through shared inventive actions, ideas, and knowledge (Casarejos et al., 2017; Buckler and Creech, 2014). For example, through an assessment of the university's strategic and sustainability reports, Farinha et al. (2019) evaluated the length by which sustainability has been integrated into Portugal universities and found that many universities showed progress and initiatives towards SD.

Table 1. Overview of Sustainable Development Initiatives

Year	Declaration or Events	Focus/Stakeholders
2021	Acting and Educating for Sustainable Development at Universities	Higher Education
2018	The International Network for Government Science Advice (INGSA) Manifesto for 2030: Scientific Advice for Global Goals	Society; Policymakers
2017	Declaration of Ethical Principles in relation to Climate Change	Society; Policymakers
2017	PRME statement in Defence of Universal Values and Principles as Preconditions for RME	Higher Education
2015	University of Gothenburg ISCN-GULF Charter report	Higher Education
2015	Sustainable development in action	Society
2014	The Lima Ministerial Declaration on Education and Raising Awareness	Society; Education
2014	Aichi-Nagoya and Nagoya's Declaration on Higher Education for Sustainable Development, Japan	Higher Education
2014	American University Sustainability Plan (An active pursuit of Sustainability)	Higher Education
2013	University Policy: Sustainable Purchasing, American University	Higher Education
2012	Higher Education Declaration for Rio+20	Higher Education
2012	The People's Treaty on Sustainability for Higher Education	Higher Education
2010	University for Sustainable Development Declaration	Higher Education
2010	UNICA Green Academic Footprint Pledge	Higher Education
2009	The Abuja Declaration – Role of HE in SD, Nigeria	Higher Education
2009	World Conference on Higher Education	Higher Education
2008	Statement of Action on Climate Change, Canada	Higher Education
2008	G8 University Summit Sapporo Sustainability Declaration, Japan	Higher Education
2008	Promotion of Sustainability in Postgraduate Education and Research Network Charter	Higher Education

Source: HESD, 2021

As there is no question on the responsibilities of HEIs towards contributing to a sustainable and resilient society, several HEIs have their ways of implementing these

commitments. However, the recommended approach is holistic, as suggested by UNESCO Paris (Caeiro and Azeiteiro, 2020). Several authors have researched sustainability in education at several universities across Europe. In Spain, Filippo et al. (2019) evaluated Spanish universities' scientific activities and reported that they still have room for improvement regarding projects and research for sustainability. Based on the results from the study in Spain and Portugal (Caeiro and Azeiteiro, 2020), there is a call for the unification of a goal and continuous enhancement of the sustainability assessment tool and its application.

Zsoka et al. (2013) also points out that students have a wide range of interests therefore universities should consider these variations so they can find ways to reach students that are normally uninterested in environmental actions. Hence, Dagiliūtė et al. (2018) suggest that universities should include students more holistically in sustainability activities and not focus on only including sustainability as a subject in curriculums.

As one of the largest group of stakeholders in any university, students have the capacity to impact sustainability at high levels (Dagiliūtė et al., 2018) however, are impaired, due to lack or restricted access to information in institutions and other factors like inadequate sustainability engagement of admin staff or non-progressive organizational structure, all limiting the extent to which all stakeholders in an institution may cohesively make sustainability related decisions or activities.

Sustainable development involves the environment, society, and economy, and as such makes a good fit in all programs of study (Dagiliūtė et al., 2018). Furthermore, Dagiliūtė and Liobikienė (2015) acknowledges that the main objective of a sustainability curriculum is to improve student’s environmental knowledge and encourage environmental concern.

Fisher and Bonn (2017) recognize that it is usually tasking for HEIs to infuse sustainability into activities, and even across activities especially when it comes to learning and teaching practices. Therefore, it is the responsibility of a university to provide different options and opportunities for multiple branches of sciences and address a wide range of views towards a more pro-environmental and sustainable development.

In Nigeria, the concept of sustainable education is addressed in the form of environmental education. In Nigeria secondary schools, young people are introduced to environmental problems such as climate change, waste, water, and land pollutions (Akeel et al., 2019). This is further acknowledged by Nigeria's policy documents like Nigeria's Agenda 2021, Nigerian vision 20:2020 and the National Education Policy, which refers to environmental education (Akeel et al., 2019). The joint admissions and matriculation board of Nigeria (JAMB) have a brochure listing all courses in Nigeria's HEIs. From this, it has been deduced that there is no HEI that at present offers a Sustainability degree (Akeel et al., 2019) despite the Abuja declaration in 2009 (HESD, 2021). This omission has not gone unnoticed as it was included in UNDESD 2014 final report.

Nigerian university students have also manifested pro-environmental behaviours (Erhabor and Don, 2016). Students from a federal university in Edo State, Nigeria, were found to be highly knowledgeable in environmental matters and to have favourable attitudes towards the environment (Erhabor and Don, 2016). In a related study, Erhabor and Oviahon (2018) indicated that apart from environmental education, majority of the students reported that their pro-environmental behaviour was also influenced by family functioning. Both family functioning and students' positive

environmental attitude significantly predicted environmental behaviours of the students according to Erhabor and Oviahon (2018).

Generally, environmental sustainability in HEIs is prevalent in scientific reporting; however, the assessment tools in many of these institutions need to be enhanced while other external and social demands should also be considered (Roos, 2019).

3. Research Questions and Objectives

The previous sections have concluded state of the research and literature. Chapter 3 contains of the following parts: 1) Research questions and purpose of the study, 2) Conceptual overview of assessing pro-environmental awareness using Sustainability Literacy Test, and 3) Conceptual Framework for evaluating pro-environmental behaviour of Nigerian students using the Theory of Planned Behaviour model.

This study poses two main research questions, as follows:

1. Research Question 1 (RQ1) – What is the level of environmental awareness amongst Nigerian university students?
2. Research Question 2 (RQ 2) – Do Nigerian University students behave pro-environmentally?

To answer these questions, three objectives of the research are developed.

For RQ1, two objectives were formulated:

4. to evaluate the environmental awareness of Nigerian university students,
5. to assess the overall sustainability literacy of Nigerian university students.

For RQ2, one objective was formulated:

6. To evaluate the PEB of Nigerian university students through the assessment of students plastic sorting intentions.

3.1. Sustainability Literacy Test – A Concept Overview for the Assessment of Pro-environmental Awareness in Nigerian Universities

The result of a universal alliance between the 'Principles for Responsible Management Education' (PRME) and Education for Sustainable development led to the creation of the Sustainability Literacy Test (SLT) (Mason, 2019). Furthermore, according to Melles and Paixao-Barradas (2019), Sulitest® was conceived between the years 2014 – 2016, stemming from the previous global collaborations between the institutions (Mason 2019). A year later, in 2017, Sulitest® was launched, and it has been reported that since its launch, several parties like companies, individuals and universities have shown considerable interest in Sulitest® (Melles and Paixao-Barradas, 2019). Sulitest® is structured as an online multiple-choice questionnaire. Institutions can register via the Sulitest® website (sulitest.org) and assign a focal point, otherwise known as the representative, to take part in the test. The questions are structured in three modules: core, customised and survey modules. The core module contains international topics, the customised module consists of geographic or local topics, and the survey modules contain cross-cutting topics. An examiner from the institution is assigned and organizes the customised questions (Akeel et al., 2019; Sulitest, 2017).

The goal of SLT is not only to improve sustainability literacy (Mason, 2019; Decamps et al., 2017) but go further to ensure HEIs, companies and other stakeholders are equipped with a world-renown tool that allows them to quantify and advance sustainability literacy (Decamps et al., 2017). According to Decamps et al. (2017), before SLT can be said to measure sustainability literacy, it must, however, satisfy certain important conditions or criteria. One requirement is that the questions created for the test should not be overwhelming and should be kept between 30 to 50

questions. Another criterion is that these questions ought to carry informative, motivating and teaching values (Sultitest.org, 2017) alongside the goal of evaluating the present knowledge on SD an individual may have.

Sulitest® is not the only existing tool for assessing sustainability awareness. There are other types like Sustainable Tool for Assessing Universities' Curricula Holistically (STAUNCH), the Green Plan, Green Metric, Sustainability Livelihood Approaches (SLA), Campus Sustainability Assessment Frameworks (CSAF) and College Sustainability report card (Zainordin and Ismail, 2018; Gomez et al., 2015). Additionally, Callewaert (2018) accounts for two other assessment tools. The 'Assessment of Student Knowledge' (ASK) is an example of an assessment tool centred on students' sustainability literacy (Zwickle et al., 2014; Callewaert, 2018). Another assessment tool that the University of Michigan created is the 'Sustainability Cultural Indicators Program (SCIP) (Callewaert 2018; Rao et al., 2010). The SCIP, as the name suggests, looks into students' campus culture, sustainability awareness, values, and behaviour.

All these tools are available to be used by individuals or corporate companies, connected by their shared goal to improve sustainable development, and measure and increase sustainability awareness (Zwickle et al., 2014). However, Sulitest® is very commonly used (Decamps et al., 2017). Over 500 universities in 57 countries have also enlisted to use Sulitest® (Decamps et al. 2017), and today more than 610 educational organisations and over 190,000 people have used Sulitest® (Sulitest.org, 2021). In addition, Sulitest® is said to require low cost or, in some cases, no cost for it to be implemented (Mason, 2019). It also allows for flexibility regarding the questions as they can be localised to fit the study population and institutions (Mason, 2019). While Sulitest® has several advantages, it is possible that several HEIs may still be

hesitant in switching to a new assessment method because it may mean that they will have to lose historical data trends, not to mention the financial loss that will become of their current data collection technique already invested in (Mason, 2019). Other limitations of Sulitest® usually pointed out is the disproportionate representation of some countries, length of the questionnaire or some restrictions from multiple choice question set up (Akeel et al., 2019). Therefore, this study modifies the features of the SLT assessment developed to overcome the limitations of the typical sulitest® model (Figure *2*).

In general, Sulitest® and other sustainability assessment tools are available to evaluate stakeholder's sustainable development knowledge (Mason, 2019), raise awareness amongst students, employees, faculty on sustainability (Melles and Paixao-Barradas, 2019), and finally to influence, teach and motivate stakeholders to act more sustainably and want to learn more about sustainable development (Mason, 2019; Decamps et al., 2017).

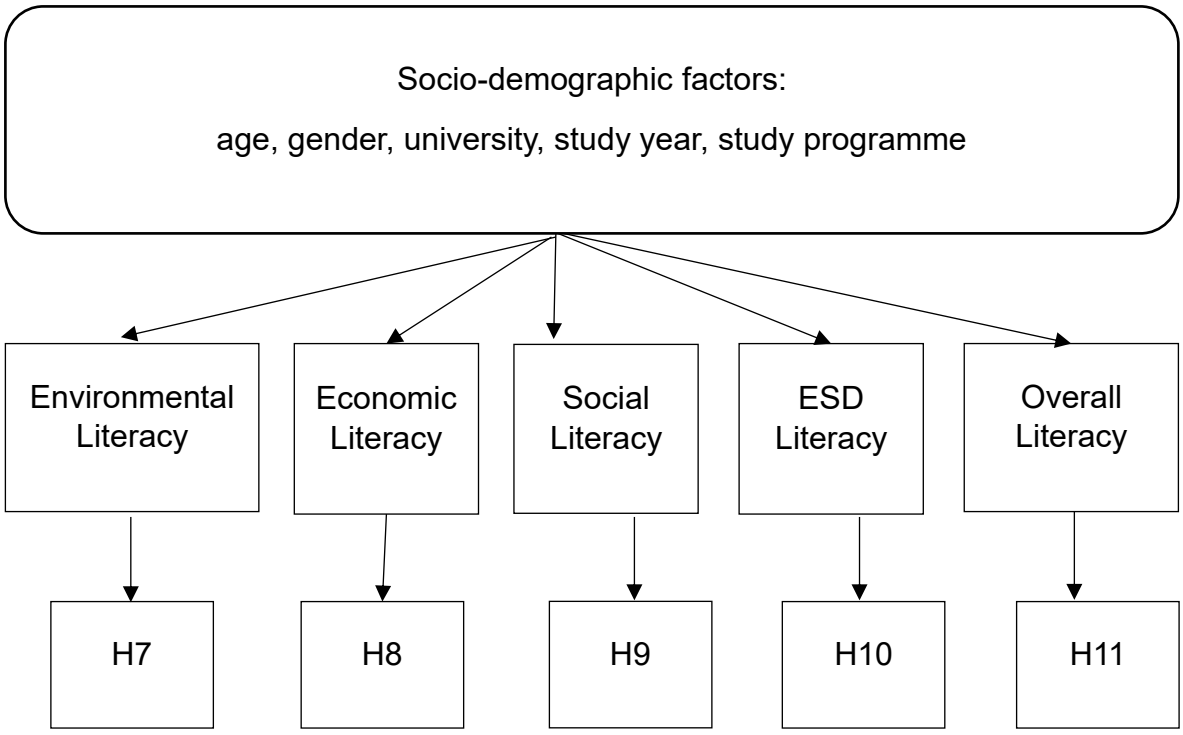

Figure 2. SLT conceptual model; Source: Author

3.2. Theory of Planned Behaviour – A Concept Overview for the Assessment of Pro-environmental Behaviour in Nigerian Universities

The Theory of Planned Behaviour (TPB) has allowed for a theoretical framework that helps comprehend plastic waste sorting intentions or the lack thereof (Greaves et al., 2013). Attitude and subjective norms often lead to perceived behavioural control (PBC) of individuals, which enables the possibility to identify the direction of an individual's intention to perform a particular behaviour or not (Otto et al., 2019; Truelove and Gillis, 2018). In plastic waste sorting among Nigerian university students, subjective norm forms the foundation of social pressure and expectation to sort plastic waste. Furthermore, PBC evaluates the situation surrounding the student's ability to sort plastic waste, thereby assessing what kind of barriers or motivators university students may face that prevent or allow them to participate in plastic waste sorting or limit their intentions to do so (Khan et al., 2020; De Leeuw et al., 2015).

Therefore, this study takes its inspiration from Ajzen (2013) to form the basis of assessing the PBC, subjective norm, and attitude that influences a Nigerian student's intention to sort plastic waste. Additionally, one of the critical drivers of social change has been attributed to university dynamics, hence amplifying students' influence in the university environment on each other regarding their attitudes and behavioural belief towards plastic waste sorting and the concept of plastic recycling (Fan et al., 2019; Klöckner, 2013). Hence, the following hypotheses have been developed:

H1: Nigerian students’ attitude positively impacts waste sorting and recycling.

H2: PBC significantly impacts Nigerian university students' waste sorting intentions.

H3: Subjective norm positively impacts waste sorting intentions of Nigerian students.

The study also acknowledges other factors relevant to plastic waste separation. This has also been recognised in Zhang et al. (2017) study, where other influencing

factors such as gender were considered in research among college students in China. For instance, the type of study programme may also affect students' plastic waste sorting intention or behaviour (Figure *2*). Furthermore, the availability of waste sorting bins (for plastics, paper, glass, tins) in university campuses reduces the external barriers for students with the intention to participate in plastic waste sorting (Zen et al., 2016). Hence, the following hypotheses have been developed:

H4: Environmental awareness of students positively impacts their waste sorting intentions.

H5: Study programme influences students' waste sorting intentions.

H6: Environmental volunteering activities positively impact students' waste sorting intentions.

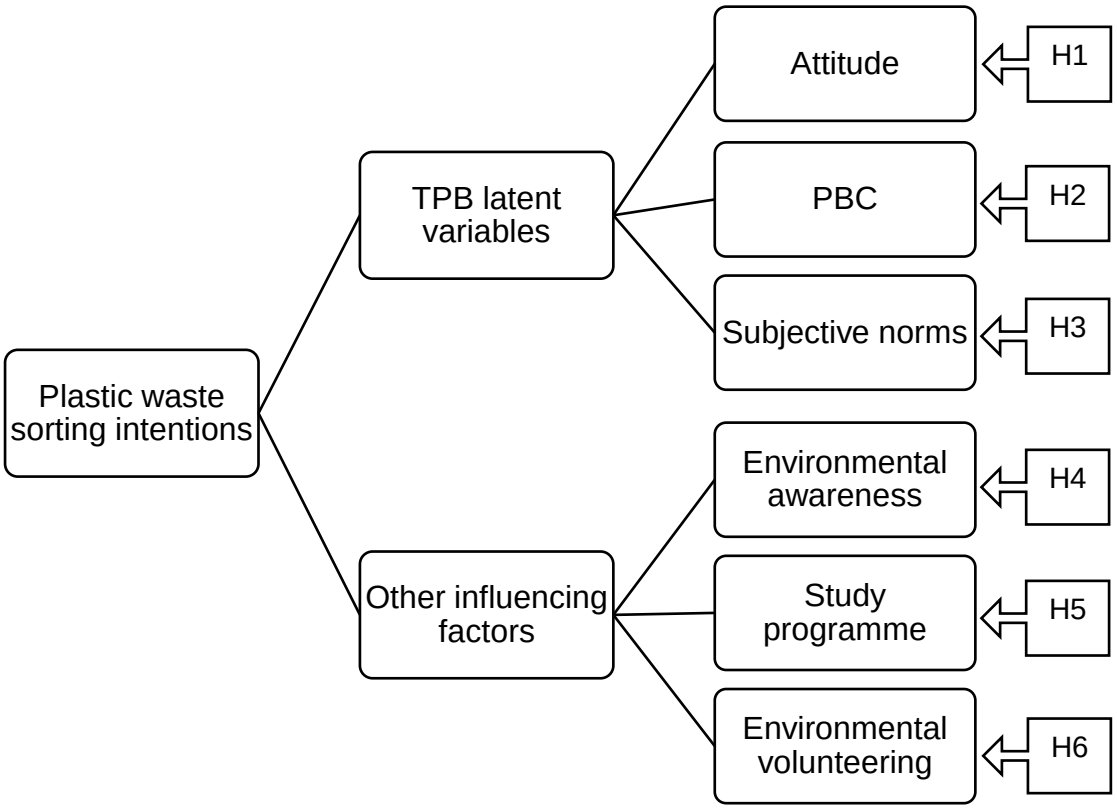

Figure 3. TPB conceptual model; Source: Author

3. Methodology

This study adapts the concept of the assessment models (TPB and SLT) mentioned earlier in evaluating Nigerian university students' environmental and sustainability literacy and plastic sorting intentions. These models are utilised to achieve the respective research objectives and address the research questions. The SLT assessment and TPB questionnaire items were administered through a paper-based questionnaire survey. The following subchapters investigate other areas of the research methodology (study area, sampling questionnaire development and data analysis) (figures 4 and 5).

4.1. Study Area

The survey took place in two Nigerian universities from June to July 2019: the Federal University of Agriculture, Abeokuta (FUNAAB) and the University of Ibadan (UI); both geographically located in Nigeria's southwest region. The criteria for selection of the universities included: (i) top 10 ranking within the region, (ii) more than 10 000 students enrolled, (iii) environmental education courses, and (iv) prominent graduates. The selected universities belong to the top 10 in the region (Mogaji, 2019); offer courses on environmental education; and are also recognised for their prominent graduates (Okebukola, 2011), some of whom have shown interest in environmental issues by lending their opinions to the matter. The sample comprised of students of the study programs involving environmental courses. At the time of the study, the number of registered undergraduate students was about 26,000 at UI and 15,000 at FUNAAB.

Figure 4. The study area

Source: Adapted from google maps

4.2. Sample Size

To assess Nigerian university students' plastic waste sorting intentions, a total of 939 students were surveyed using a paper-based questionnaire. The sampling was conducted in two stages. The first stage involved the purposive selection of the universities described above. In contrast, the second stage, inspired by the study from Taiwan by Yu et al. (2017), included a sampling of students through a cluster random sampling technique targeting three study fields - agriculture, engineering, and environment, involving all levels (1^{st} to 5^{th} year, 100L to 500L).

The questionnaire consisted of two parts based on the 7-point bipolar Likert scale (1 = 'Extremely disagree' to 7 = 'Extremely agree'). The first part contained three sections of 14 questionnaire items which included 12 statements and two questions.

The items include statements that evaluated latent construct of the TPB model, such as behavioural attitudes (4 items), subjective norms (4 items), perceived behavioural control (4 items); intention and actual behaviour, asking the students about the frequency of sorting their plastic waste (2 questions).

The second part covered other influencing characteristics of the respondents containing seven self-assessment questions on demographic data, source and updates of environmental information and environmental volunteering.

To assess the environmental awareness of the respondents, the total sample size of the study arrived at 650 students after eliminating gender bias (hereby 50% each of boys and girls were randomly selected), and questionnaires which were not properly filled. A cluster random sampling technique was applied. The sample population consists of undergraduate students (first to fifth study year) randomly selected from three study fields: environment, engineering, and agriculture. From FUNAAB, the total sample of 250 undergraduate students comprised 125 males and 125 females. Students from environmental study programmes comprised 92, while agriculture and engineering students comprised 83 and 75. In UI, the total sample achieved was 400 students, evenly distributed across gender. Similarly, the environmental students consisted of 113 amount and the agriculture and engineering student were 146 and 141 in number, respectively. The demographic characteristics of respondents are described in table 2 below.

Table 2. Descriptive of the sample population

Demographics	N = 650	Frequency %
Age (years)		
18-24	516	79.4
25-34	63	9.7
Under 18	71	10.9
Gender		
Male	325	50.0
Female	325	50.0
University		
UI	400	61.5
FUNAAB	250	38.5
Study programmes		
Agriculture	229	35.2
Engineering	216	33.2
Environment	205	31.5
Study year		
First (100L)	95	14.6
Second (200L)	178	27.4
Third (300L)	129	19.8
Fourth (400L)	150	23.1
Fifth (500L)	98	15.1

4.3. Developing the Sustainability Literacy Test (SLT) Questionnaire

The evaluation of environmental awareness and knowledge of Nigerian students was conducted via closed and open-ended Sustainability Literacy Test (SLT) survey questions. Assessment of Students' Knowledge (ASK) and Sulitest® was instrumental in developing the SLT assessment tool used in the study. However, complete adoption of both tools was not feasible for the following reasons. With Sulitest®, online application and registration by participating institutions are required to access the test.

Therefore, considering the added complicated administrative process, a registration problem could not be resolved within the study's timeframe. For ASK, within the framework of the current study, there was a need for this to be customised to be more Nigeria focused. As recommended, contextual significance is an essential requirement when designing an SLT assessment (Sulitest.org, 2017). These reasons were previously cited by Akeel et al. (2019) and presented the same complications, as it is unlikely that the participating institutions will consent to register for Sulitest® online application without an extensive administrative bureaucracy that will be time-consuming, hence resulting in its modification to fit the current study. Therefore, the study followed some of the recommended bespoke applications used by Akeel et al. (2019). These include reducing the number of questions (the study provided 15 questions on four sustainable development topics). Also, the questions contained geographically relevant environmental topics and extended from the sulitest® and ASK multiple choice standard to open and close-ended assessment questions.

As mentioned, a paper-based questionnaire survey (Appendix D) was conducted partially based on Akeel et al. (2019) questionnaire design, as well as ASK and the Sulitest® model. Although Akeel et al. (2019) administered both paper and online questionnaire delivery methods, this study used Google forms to create the pdf

questionnaire which was delivered physically to each participant. This was a better option for the location to encourage high response rates by an in-person explanation of the aim of the study. The questionnaire was designed to be answered within a 15-minute time frame. There were three class heads (otherwise known as HOC) from the three designated study programmes appointed representatives to oversee the SLT. They (HOCs) also assisted in administering the survey. The students were formally informed of the aim and relevance of the study and were assured of their anonymity. Also, they were made to understand the importance of being honest during participation. The university itself did not design the test to implicate actual study grades but only to assist the authors in their research and for full disclosure.

There were 21 questions in total. The SLT questions consisted of two parts. Respondents were assessed based on the five areas included in the SLT. The first four areas were environmental, economic, social, ESD knowledge or literacy, and the fifth was an overall literacy assessment. The first part had 15 questions in all. They included six environmental, three social, three economic and three questions on education for sustainable development (ESD). The second part contained five demographic questions. The questions were mixed to avoid linked or modular test features, as suggested by Akeel et al. (2019). The SLT was also structured not to ascertain expert sustainability knowledge but rather the foundational literacy of the students. It is important to note that in addition to the Sulitest® and ASK multiple-choice setup, some of the questions also included true, false or 'I don't know' options as used by Akeel et al. (2019). Some questions conformed with ASK and Sulitest® multiple-choice design; in contrast, others included the stated addition from Akeel et al. (2019) and other slight modifications to the questionnaire design. These adaptations allowed for uniqueness to this study. Appendix A and B describes the structure and

characteristics of the SLT questions while appendix C Summarises the SLT questionnaire and how they were arranged.

4.4. Developing the Theory of Planned Behaviour (TPB) Questionnaire

The TPB framework was applied to explain the student's intention toward plastic waste sorting. The TPB constructs used in this study is demonstrated in Table 3. Subjective norms, as recommended by Ajzen (2013), contained two aspects, injunctive norms (what is expected of the students by revered individuals) and descriptive norms (what social norm dictates as appropriate behaviour, as in what others are supposedly doing) (Wan et al., 2017). In this study, items measuring subjective norms contained questions referring to revered individuals such as 'people I look up to', 'my classmates', 'my friends' as suggested by Ajzen (2013) as referents within the TPB model.

Additionally, to measure students' PBC toward plastic waste sorting, selected questions reflected on a student's feeling of confidence to overcome barriers such as limited or lack of opportunities (bins, distance, time, effort) to sort plastic if they wanted to. The students' intention to sort plastic waste was measured by combining questions that informed them about students' intention to carry out plastic sorting activities in earnest and those that reported past plastic waste sorting activities in the last two weeks. The latter was also used to measure future intention's strength to continue this behaviour, as Ajzen (2013) recommended.

The TPB constructs claim that subjective norm, PBC (Mak et al., 2019; De Leeuw et al., 2015), and attitude can cohesively explain an individual's behaviour and intentions with high accuracy levels (Ajzen, 1991; Yuriev, 2020). Hence to meet the third requirement for the TPB construct, the attitude was measured with questionnaire items

related to perceived personal benefits, environmental pros, profits or loss, difficulties or simplicity that can be accrued by sorting plastic waste.

4.5. Data Analysis

To find out the differences between the socio-demographics (Figure *3*) the study carried out a multivariate analysis of variance and Chi-square (χ^2) (Akeel et al., 2019). To project high or low literacy levels, the areas were assigned dichotomous (pass or not passed) scores based on how many questions were answered correctly in each SLT domain. For the environmental questions, students are expected to get at least two questions correctly out of six to be placed in the pass category. In contrast, for the other SLT domains (economics, social and ESD), students needed to answer at least one question correctly out of three to be placed in the pass category. Students need to get at least five correctly answered questions out of 15 to be placed in the pass category in the final overall domain. The selection of pass marks is based on the number of correctly answered questions in each domain and overall. For the environmental field, four was determined to be the highest score out of six possible outcomes and in the overall SLT questions, 10 was the highest score out of 15 (Akeel et al. 2019). To carry out the inferential and descriptive statistics on the SLT assessment, the study utilized SPSS version 23.0.

The TPB model was analysed using Statistical Package for Social Science (SPSS version 23.0) and the analysis of moment structures (Amos SPSS module). Descriptive statistical data of the TPB model and other influencing factors were presented by mean values, standard deviations, frequency distributions and percentages. Exploratory and confirmatory factor analyses were done on the pro-environmental items. After that, a structural equation model (SEM) was used to determine the influence of TPB factors on plastic waste sorting intention. Furthermore, path analysis was also carried out to analyse the impact of other influencing variables in this study on plastic waste sorting intention.

SEM simultaneously estimates the measurement models used to identify latent and structural variables. Therefore, for examining the connections between variables, the fitness of this model was analysed by following proposed analytical indices: root means square error of approximation (RMSEA), comparative fit index (CFI), maximum likelihood chi-square (X^2), Ticket Lewis index (TLI) and root mean square residual (SRMR). Accordingly, the following standards can be used for assessing SEM: RMSEA_0.06, CFI_0.95, TLI_0.95, and NFI_095 (Kline, 2015).

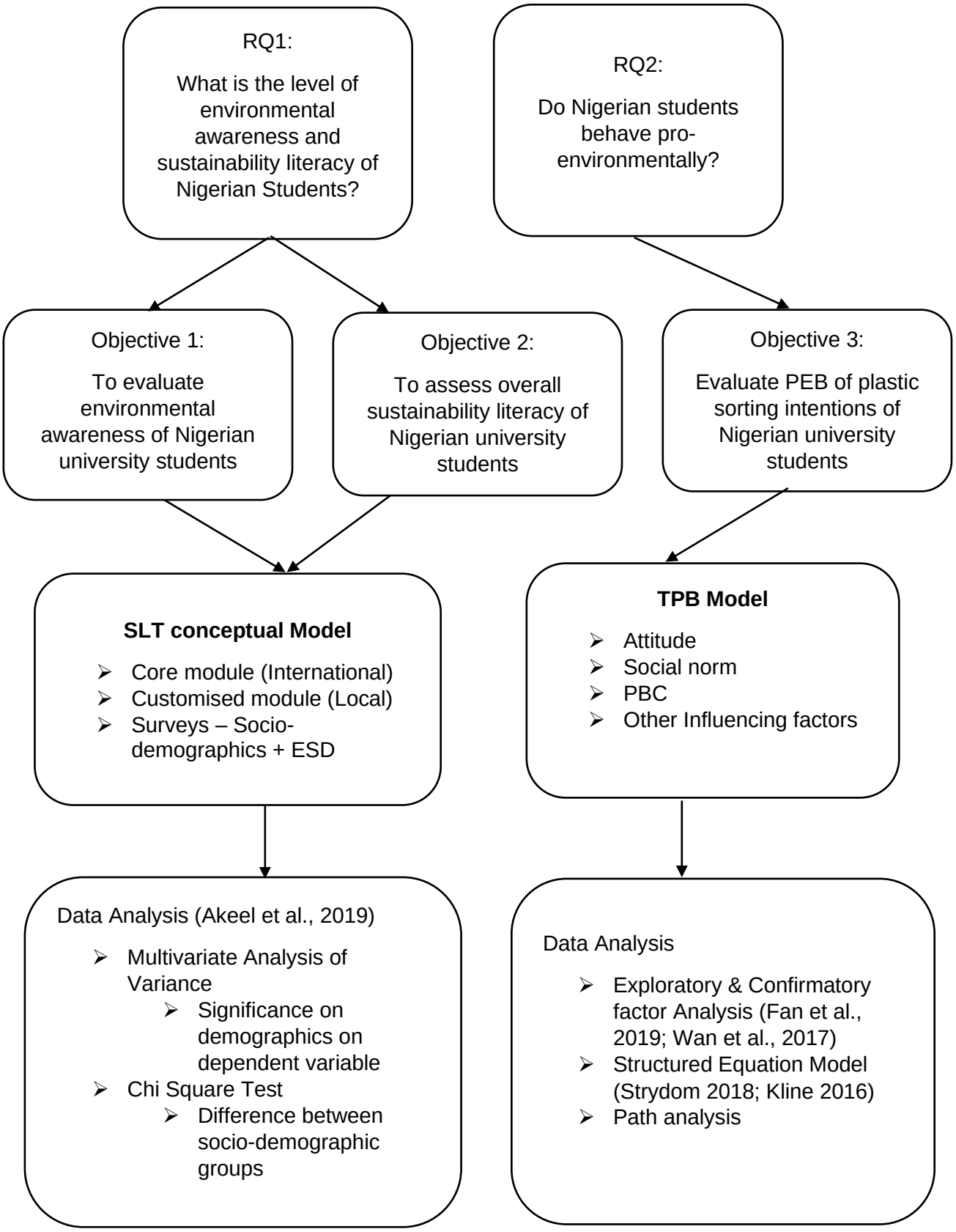

Figure 5. Research methodology overview; Source: Author

Table 3. TPB Questionnaire items
(Adapted from the TPB construct developed by Ajzen (2013))

Latent construct	Description	Symbol
Attitudes towards plastic recycling and plastic waste sorting **(AT)**		AT
	Plastic recycling will improve environmental sanitation.	AT1
	Waste sorting for plastic recycling is a good use of my effort.	AT2
	Waste sorting brings financial rewards.	AT3
	Waste sorting is a good use of my free time.	AT4
Subjective norms towards plastic waste sorting **(SN)**		SN
	Classmates will approve of me gathering plastic for recycling.	SN1
	People I revere will be pleased to see me sort plastic.	SN2
	My friends always separate plastic for recycle.	SN3
	It is expected that I sort plastic for recycling.	SN4
Perceived behavioural control towards plastic waste sorting **(PBC)**		PBC
	Several opportunities for waste sorting exist around me.	PBC1
	Nothing prevents me from sorting plastic waste regularly.	PBC2
	Choosing to sort plastic is solely dependent on me.	PBC3
	The distance to a recycling centre is very far.	PBC4
Intention towards plastic waste sorting **(INT)**		INT
	I will commence plastic waste sorting from now on.	INT1
	Frequency of my plastic sorting activity in the last 2 weeks	INT2

5. Results and Discussions

5.1. Descriptive findings from TPB model results

The total respondent sample from FUNAAB is 444 students. The study identified youth groups between 18 to 34 years old at the undergraduate level. The age group with the highest number of students were within the age range of 18 to 24 years.

There was a near-even distribution of students across the study programme as agriculture and engineering were represented by 150 students. In comparison, environmental science had 144 students who took part in the study (Table 4). However, the gender representation reveals more males than females (67.0% and 32.0%, respectively). In general, more males than females were represented across the individual study programmes also from the sample collected. There were 55.3% males and 44.7% females for agriculture students, while in the environmental study programme there were twice as many males (66.7%) than females (33.3%). The gap is considerably higher for engineering as there was a 79.3% to 20.7% ratio of males to females. The gender bias in the mentioned study programme, especially in the engineering field, highlights the need for more gender-inclusive initiatives in universities (Delaney and Devereux, 2019).

Students in 400L had the most representation, as seen in Table 4, followed by students in their final and second year of study. Furthermore, 66.4% of the students responded that their primary source of environmental information is the media, while 30.9% chose the university as their primary source. The media plays a significant role today in environmental news and the promotion of environmental campaigns (Junsheng et al., 2019). Nonetheless, evidence from this study suggests that universities should also become equally reliable in providing students with information

related to the environment, which is the case for some universities already, as reported by Dagiliūtė et al. (2018) in a study conducted in a Lithuanian green university.

There was a total sample of 495 student population from UI from FUNAAB. Similarly, to FUNAAB, the predominant age group fell within 18 to 24 (79.8% of students), with the minor recurring age group of students (8.5%) represented by 25 years and above. The gender distribution was also skewed in the study programme, as seen in FUNAAB. The male to female population was not over-represented by males showing a near even distribution with 57.0% of males and 43.0% of females.

However, there were 76.5% males to 23.5% of females when it comes to the engineering study programme. Although, in the field of agriculture, there were more female students than males (50.9% and 49.1%, respectively) and even more females in the environmental science program (58.0% females to 42.0% males). Having more female students in the environmental science program may indicate that girls show more interest and concern with environmental issues, as some studies have suggested (Xiao and McCright, 2015). However, this study does not go further into gender.

Furthermore, more students in the mid-early stages of their university level (30.7% and 24.4% of respondents for 200L and 300L, respectively) participated in the study. Similarly, as found with FUNAAB, most of the students from UI chose the media (61.6%) as their primary source for environmental information, while the other 33.9% chose the university as their primary source of getting environmental information (Table 4).

Table 5 illustrates the findings of the TPB items' descriptive results, whereas table 6 comprises the results of students' demographic and other influencing factors.

Table 4. Characteristics of respondents in the PEB assessment

Variables	FUNAAB (n=444)		UI (n=495)		Total (n=939)
	No	%	No	%	
Gender					
Male	298	67.0	282	57.0	580
Female	146	32.0	213	43.0	359
Age (years)					
≤18	37	8.3	58	11.7	95
18-24	345	77.7	395	79.8	740
25-34	62	14.0	42	8.5	104
Study Programme					
Agriculture	150	33.8	173	34.9	323
Engineering	150	33.8	179	36.2	329
Environment	144	32.4	143	28.9	287
University level					
100L	42	9.5	80	16.2	122
200L	95	21.4	152	30.7	247
300L	65	14.6	121	24.4	186
400L	144	32.4	101	20.4	245
500L	98	22.1	41	8.3	139
Environmental Volunteering (I am an active member of a voluntary environmental organisation.)					
Yes	52	11.7	68	13.7	120
No	392	88.3	427	86.3	819
Environmental awareness (I always follow environmental news.)					
Yes	188	42.3	203	41.1	391
No	256	57.7	292	59.0	548
Source of Environmental information					
University (1)					
Media (2)	137	30.9	168	33.9	305
Both (3)	295	66.4	305	61.6	600
	12	2.7	22	4.4	34

5.2. Structural Equation Modelling (SEM) Criteria

The TPB results show that the standardised regression estimates are all significant at $P < 0.001$, which indicates the items are good measures of the four TPB criteria. The covariance estimates of the TPB model's latent structures were also statistically significant at $P < 0.001$.

The TPB model showed a good fit based on root mean square error of approximation (RMSEA) and baseline comparisons of comparative fit index (CFI), Tucker Lewis index (TLI), norm fit index (NFI) criteria being 0.020, 0.996, 0.988, 0.985 respectively. Furthermore, the model achieved the values for Chi-square $\chi^2 = 45.4$, $df = 33$, $p=0.74$, which implies a good representation of the data. This study collectively shows that PBC, attitude and subjective norm contributed to 76.5% variance in plastic waste sorting intention. These criteria conform to similar studies where SEM is used to analyse the TPB model's latent variables (Hu and Bentler, 1999; Sutton, 2014).

Table 5. Descriptive statistics of TPB items and their respective regression weights *(N=939)*

TPB Items	Mean*	SD	Loadings
AT1: Plastic recycling will improve environmental sanitation.	6.01	1.68	0.54***
AT2: Waste sorting for plastic recycling is a good use of my effort.	5.30	1.60	0.83***
AT3: Waste sorting brings financial reward.	5.76	1.55	0.49***
AT4: Waste sorting is a good use of my free time.	5.05	1.69	0.79***
SN1: Classmates will approve of me gathering plastic for recycling.	3.93	1.75	0.38***
SN2: People I revere will be pleased to see me sort plastic.	4.02	1.92	0.56***
SN3: My friends always separate plastic for recycling.	2.76	1.83	0.58***
SN4: It is expected that I sort plastic for recycling.	3.54	1.87	0.76***
PBC1: Several opportunities for waste sorting exists around me.	4.47	1.96	0.56***
PBC2: Nothing prevents me from sorting plastic waste regularly.	4.21	1.95	0.68***
PBC3: Choosing to sort plastic is solely dependent on me.	4.90	1.87	0.53***
PBC4: The distance to a recycling centre is very far.	4.71	1.77	0.43***
INT1: I will commence plastic waste sorting from now on.	3.73	1.91	0.28***
INT2: Frequency of my plastic sorting activity in the last 2 weeks.	0.68	1.65	0.70***

*Bi-polar scale: 1=extremely disagree to 7=extremely agree, ***P < 0.001

5.3. Attitudes toward Plastic Waste Sorting

The results showed that students' attitude towards plastic waste sorting is not statistically significant (with *P-value of 0.66*) to plastic waste sorting intentions. Hence, H1 (*Nigerian students' attitude positively impacts waste sorting and recycling*) is rejected even though the study reveals a positive attitude towards waste sorting intentions. Furthermore, this suggests that even though students have a positive attitude to plastic waste sorting as it improves environmental sanitation, this does not always lead to an increased intention to sort plastic waste accordingly. Conversely, some studies have reported a negative attitude associated with plastic recycling; for instance, in South Africa's where city residents reported a negative attitude towards plastic sorting according to Strydom (2018) findings.

Even though plastic waste sorting attitudes were measured according to behavioural beliefs surrounding environmental benefits, *attitude* was still not statistically significant from the findings of this study. The result on environmental attitude from this study is very similar to a related study involving Maltese university students as it was also established that Maltese students' attitude towards the environment was highly positive (Mifsud, 2011). However, these positive attitudes towards the environment were weakly manifested in their actions towards the environment.

Undergraduate students from Brazil and Portugal have also been reported to have a good level of concern for the environment and pro-environmental attitude (Côrtes et al., 2016). However, Portuguese students showed a lower level of environmental concern and attitude than their Brazilian colleagues. Although the study found Brazilian students were more concerned about environmental issues than their Portuguese counterparts (Côrtes et al., 2016). This was manifested by Brazilian

students' greater preference for consumption of greener products than the Portuguese students (Côrtes et al., 2016).

Attitude change is a crucial aspect of promoting environmental behaviour (Johnson and Činčera, 2015). This is seen in a sample of Czech and United State students, where it was reported that instilling pro-environmental attitudes to students was found to lead to personal behaviour change (Johnson and Činčera, 2015).

Therefore, as Ahmad et al. (2016) suggested, students especially those from developing countries still need to be educated on the importance of plastic recycling activities to improve their attitudes towards plastic recycling in general. This could then transform behavioural beliefs to personal behaviour change.

5.4. PBC towards Plastic Waste Sorting

The study also reveals significant correlations between the latent variables (*Figure 6*). The correlations depict the relationship between students' attitudes towards *waste sorting intentions* and *subjective norms* (*0.28***)* and the *perceived behavioural control (PBC)* exhibited by students towards waste sorting behaviour (*0.41****).

PBC showed the highest standardised effect on students' *waste sorting intentions* at *0.52**** (H2 accepted). When asked if they are confident in their own ability to sort plastic waste for recycling if they chose to, 69% and 61% of students from FUNAAB and UI, respectively, responded in agreement to this question. Hence, this implies that internal limiting barriers do not modify the *waste sorting intentions* for the students. However, the students (60% of respondents at both universities) responded that a recycling centre's distance is very far from the university residence. Implying that there are external barriers beyond the students control factors in their intentions to sort plastic waste for plastic recycling purposes.

This result suggests that *PBC* by eliminating external barrier is a significant factor explaining waste sorting intentions. This aligns with the study by Wang et al. (2021) on consumers' waste sorting intentions in China where similar findings has been reported.

To promote desired pro-environmental behaviours, elimination of barriers ought to be given serious consideration. In a study conducted at Bournemouth University, England, the main barriers to pro-environmental behaviours were found to be institutional hurdles, funding, and time (Scarborough and Cantarello, 2018). This study also finds hurdles such as lack of basic infrastructure, like recycling bins to be limiting. Therefore, it is goes without saying that efforts should be made to work on these hurdles to promote pro-environmental behaviours. Consequently, it is recommended

in addition to environmental education, the presence of environmental structures associated with pro-environmental behaviour (e.g., recycling bins) are crucial components in promoting students' pro-environmental behaviours.

5.5. Subjective Norm towards Plastic Waste Sorting

Additionally, many of the students in this study (69%) did not feel that their peer sorted plastic for recycling, indicating a low pro-environmental identity amongst Nigerian students. However, this is not always the case. Freed and Wong (2019) investigated whether environmental identity was linked to pro-environmental behaviour among U.S. university students. The authors established that both students with lower and higher lower pro-environmental identity engaged in pro-environmental behaviour (recycling) regularly (Freed and Wong, 2019).

Furthermore, Vicente-Molina et al. (2013) established that students from developed and developing countries have differences in pro-environmental behaviour — with those of developed countries being more pro-environmental. Differences in pro-environmental behaviour of university students from developed and developing countries were attributed to services in each country, environmental structures, and culture. In both groups, pro-environmental behaviour was attributed to motivation and perceived effectiveness. Once again highlighting the importance of having environmental structures (separation bins or recycling centres) in place to aid plastic sorting intentions as this study also finds.

Subsequently, this study further reveals *subjective norms* towards *waste sorting intention* to be significant at *0.45**** (H3 is supported). As earlier mentioned, many students reported unfavourably to their peers partaking in plastic separation for recycling (FUNAAB = 69.1% disagree; UI = 65.7% disagree). Thus, the students did

not feel that their peers were sorting plastic (69% of students from FUNAAB and 66% from UI reported that they disagreed that their classmates separated their plastic waste). This finding differs from a similar study by Fan et al. (2019) in Singapore and Shanghai, where it was reported that the people focused on surrounding opinions related to recycling and sorted waste as it is deemed socially appealing. Furthermore, according Wan et al. (2017) findings, emphasises subjective norms' influence on recycling intention. However this study reports similar prior findings by Strydom (2019) in South Africa, where it was found that majority of the respondents reported a lack of social pressure to sort for recycling. The correlations and positive relationships between the latent constructs are presented in figure 6.

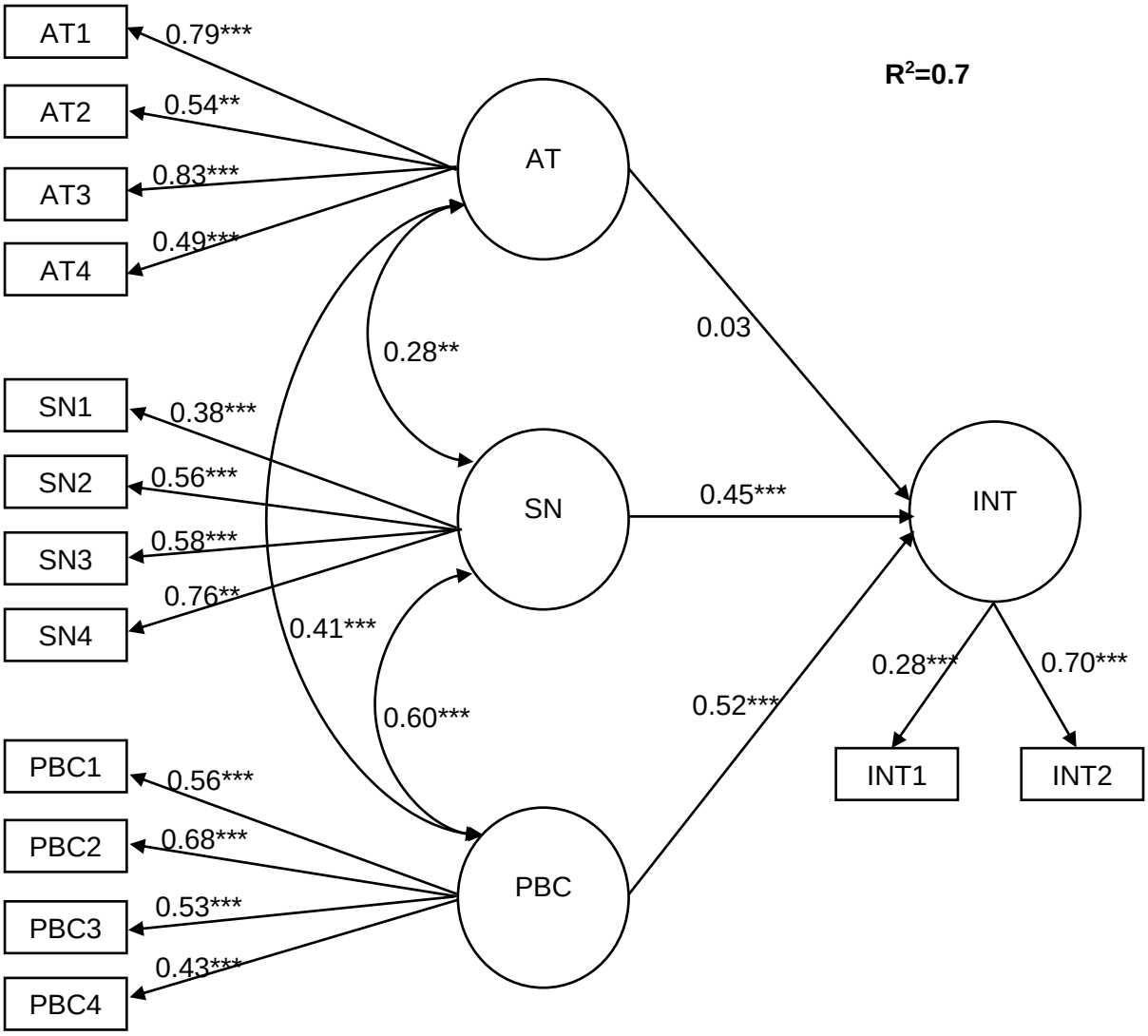

Figure 6. SEM results; Source: Author

Standardized path co-efficient; notes: RMSEA=0.02, CFI=0.99, TLI=0.99, NFI=0.99, X2 = 45.4, ***P < 0.001

5.6. Other Factors Influencing Student's Plastic Waste Sorting Intentions

As mentioned earlier, TPB constructs alone will be insufficient to understand the underlying cause of plastic waste sorting by Nigerian students. Thus, it is necessary to look at the impact of other influencing factors such as *gender*, *age*, *study programme*, *university level*, *environmental awareness*, *participation in voluntary environmental organisations*, and *source of environmental information*. The path analysis findings reveal that students are interested in following environmental news, an item used to measure environmental awareness shows a significant impact at $P < 0.01$, intending to sort plastic waste, which supports H4 (e*nvironmental awareness of students positively impacts their waste sorting intentions*).

In similar a study, *environmental awareness* is said to be an essential factor in promoting plastic sorting initiatives (Ogunbode and Arnold, 2012). Dagiliūtė et al. (2018) also emphasizes on the need to raise awareness among students and staff on sustainability. As highlighted by Avila et al. (2017), lack of awareness is one of the main hindrances for sustainability in universities.

Thus, this study finds that increasing environmental awareness will encourage students' interest in environmental issues and consequently advance plastic recycling initiatives. *Environmental awareness* and pro-environmental behaviour of youths are of great importance to researchers and climate change enthusiasts. Among youths, researchers have investigated whether university students' pro-environmental behaviour can be improved by equipping the students with relevant environmental knowledge.

The results also show that the *study programme* (statistically significant at $P < 0.02$; H5 is accepted) and *environmental volunteering* (H6 is accepted) influence students' waste sorting. This also demonstrates a significant impact on students' plastic waste

sorting intentions, as this study finds (*P < 0.001*). Dagiliūtė and Liobikienė (2015) also corroborates this result as they claim that to promote environmental behaviour amongst students, universities should ensure environmental programmes are represented accordingly in the curriculum.

Furthermore, Dagiliūtė et al. 2018 went on to recommend that universities should still improve sustainability curriculums as their study demonstrated that students still had a lot to learn on sustainability and related subjects. Like in the current study, it was found that among Chilean university students, those who pursue environment courses were found to be more likely to show a higher frequency of pro-environmental behaviours than those who do not.

This study also determined *environmental volunteering* to be statistically significant. This is in line with Zsoka et al. (2013), claiming that pro-environmental behaviour can be actualised by promoting students' environmental activities within Hungarian universities. Another endorsement of active learning has been reported by Ajaps and McLellan (2015) as they indicated that the students' required environmental education content given to them through practical approaches such field excursions.

Table 6. Descriptive statistics of other influencing factors in the study *(N=939)*

Variables	Frequency (%)	Mean	SD	P value
University level		3.03	1.28	0.01**
1st year (1)	13			
2nd year (2)	26.3			
3rd year (3)	19.8			
4th year (4)	26.1			
5th year (5)	14.8			
Study programme		1.96	0.81	0.02**
Agriculture (1)	34.4			
Engineering (2)	35.4			
Environment (3)	30.6			
Environmental awareness – I always follow environmental news		1.58	0.49	0.01**
Yes (1)	41.6			
No (2)	58.4			
Environmental volunteering – I am an active member of a voluntary environmental organisation		1.87	0.33	0.001***
Yes (1)				
No (2)	12.8			
	87.2			

**P < 0.05, ***P < 0.01 N=650

Variables like *gender* and *source of environmental information* were also considered other potential influencing factors in this study's preliminary stages*;* however, their influence on plastic waste sorting has not been statistically significant. Gender has been applied in previous pro-environmental studies as a significant factor in determining pro-environmental inclinations between genders (Vicente-Molina et al., 2018). In this study, however, gender does not influence plastic recycling or plastic waste sorting intentions. This agrees with results from a similar survey among

university students in Spain by Vicente-Molina et al. (2018) on recycling, where gender was also not found to be relevant.

Additionally, authors have attributed higher level of environmental consciousness to higher educational level, and according to Meyer (2016) findings, an additional year of education increases the likelihood of environmental behaviour. This is in line with current study as university year was similarly found to be statistically significant. Nonetheless, Sammalisto et al. (2016) may have found an increase in students' knowledge over time but however reported that with environmental behaviour, environmental education did not prove significant

5.7. Descriptive Findings from Sustainability Literacy Test

From the 15 SLT questions, Q6 and Q11 (Q6: Long-term profitability is the most commonly used definition of economic sustainability, and Q11: Many countries became independent and joined the United Nations as a result of decolonization) were the most correctly answered questions where more than half of the students in the entire sampling population chose the correct answers (64.9% and 54.9%). Q1 on Ozone layer an environmentally focused question, was found to be the least correctly answered in the study. 87.7% of the student answered this question incorrectly while 6.6% answered correctly, the remaining 5.7% chose 'I don't know'. Among the local environmental question, Q14, which inquired about Nigeria's environmental act, over two-thirds of the students were unable to answer as 79.4% of the student chose 'I don't know' to this question. The incorrect and 'I don't know' answers are grouped as one and categorised dichotomously alongside correct answers to present the possibility to pass or not pass based on the assessment criteria.

To describe the findings with respect to socio-demographics against the SLT questions is as follows. The *age group* with the most correct answers (30.2%) were 25 to 34 years which is the highest age group in the study. The other age group having 19.8% in the 18-24 age group and 23.9% among the under 18 years for correctly answered questions. For *gender*, there was only a marginal difference in the frequency of correctly answered questions between male and female respondents (22.2% and 20.3%, respectively). Almost exactly as gender, the case of the two *universities* (UI and FUNAAB) in the study was found to vary by 2%, with UI having 22.0% and the latter 20% of correct answers. The performance across the *year of study* was found to be generally poor; however, students in their first year had the highest correct answers (10.5%), while the least score was recorded among students in their fourth year

(4.0%). The Chi-square contributions of the level of performance on SLT topics within the sociodemographic are expressed in table 7 and table 8.

Table 7. Chi-square contribution of socio-demographics against environment and economics domain

Factors	**Environment**				**Economic**			
	Passed (N)	Passed (%)	Not Passed (N)	Not Passed (%)	Passed (N)	Passed (%)	Not Passed (N)	Not Passed (%)
Age (years)								
18-24	31	6.0	485	94.0	447	88.6	69	13.4
25-34	5	7.9	58	92.1	55	87.3	8	12.7
Under 18	2	2.8	69	97.2	61	85.9	10	14.1
Total	38	5.8	612	94.2	563	86.6	87	13.4
Gender								
Male	21	6.5	304	93.5	292	89.8	33	10.2
Female	17	5.2	308	94.8	271	83.4	54	16.6
Total	38	5.8	612	94.2	563	86.6	87	13.4
University								
UI	28	7.0	372	93.0	338	84.5	62	15.5
FUNAAB	10	4.0	240	96.0	225	90.0	25	10.0
Total	38	5.8	612	94.2	563	86.6	87	13.4
Level								
100L	10	10.5	85	89.5	85	89.5	10	10.5
200L	8	4.5	170	95.5	145	81.5	33	18.5
300L	8	6.2	121	93.8	110	85.3	19	14.7
400L	6	4.0	144	96.0	132	88.0	18	12.0
500L	6	6.1	92	92.3	91	92.9	7	7.1
Total	38	5.8	612	94.2	563	86.6	87	13.4
Field								
Agriculture	17	7.4	212	92.6	201	87.8	28	12.2
Engineering	6	2.8	210	97.2	178	82.4	38	17.6
Environment	12	7.3	190	92.7	184	89.8	21	10.2
Total	38	5.8	612	94.2	563	86.6	87	13.4

Table 8. Chi-square contribution of socio-demographics against social and ESD domain
(N=650)

Factors	**Social**				**ESD**			
	Passed (N)	Passed (%)	Not Passed (N)	Not Passed (%)	Passed (N)	Passed (%)	Not Passed (N)	Not Passed (%)
Age								
18-24	107	20.7	409	79.3	400	77.5	116	22.5
25-34	21	33.3	42	66.7	55	87.3	8	12.7
Under 18	22	31.0	49	69.0	55	77.5	16	22.5
Total	150	23.1	500	76.9	510	78.5	140	21.5
Gender								
Male	72	22.2	253	77.8	248	76.3	77	23.7
Female	78	24.0	247	76.0	262	80.6	63	19.4
Total	150	23.1	500	76.9	510	78.5	140	21.5
University								
UI	92	23.0	308	77.0	327	81.8	73	18.3
FUNAAB	58	23.2	192	76.8	183	73.2	67	26.8
Total	150	23.1	500	76.9	510	78.5	140	21.5
Level								
100L	26	27.4	69	72.6	73	76.8	22	23.2
200L	35	19.7	143	80.3	135	75.8	43	24.2
300L	30	23.3	99	76.7	105	81.4	24	18.6
400L	36	24.0	114	76.0	121	80.7	29	19.3
500L	23	23.5	75	76.5	76	77.6	22	22.4
Total	150	23.1	500	76.9	510	78.5	140	21.5
Field								
Agriculture	69	30.1	160	69.9	183	79.9	46	20.1
Engineering	40	18.5	176	81.5	166	76.9	50	23.1
Environment	41	20.0	164	80.0	161	78.5	44	21.5
Total	150	23.1	500	76.9	510	78.5	140	21.5

5.8. Performance by Sustainability Literacy Test Topics

Table 9 displays the results of the multivariate analysis of variance evaluating the performance of respondents against SLT topics. The effect size of the findings in all but three statistically significant findings mainly were less than 1% (Table 9). However, besides the *study level or year*, all the other demographic factors were statistically significant, varying by the SLT domain with the exclusion of environmental knowledge.

The performance related to environmental knowledge was determined to be poor across the study (Figure 7); however, there is no statistical evidence to implicate socio-demographic factors that may influence Nigerian students' level of environmental literacy. Hence, the null hypothesis is accepted, and H7 is rejected. Further tests between subjects based on the pass and not passed criteria reveal over 90% of the students with low performance in the environmental domain; nevertheless, engineering and students under 18 years recorded the lowest performance of 97.2% (Table 7).

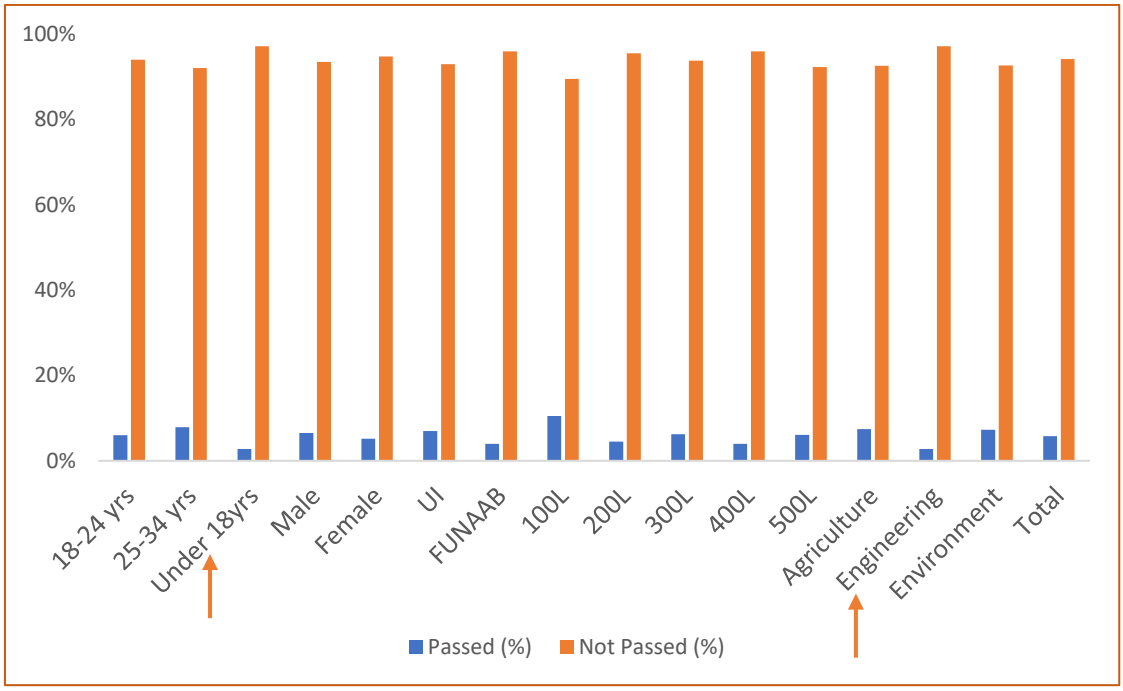

Figure 7. Performance on environmental topics; Source: Author

For the economic domain, *gender* and *university* are found to be slightly statistically significant (*P=0.016* and *0.045* respectively), thereby projecting an influence on the performance on economic sustainability literacy. Therefore, we accept H8 and reject the null hypothesis. According to the findings, males performed only slightly better than females and FUNAAB better than UI (Table 7). The other demographics – age, study year and field were not found to be significant. Conversely to the environmental SLT, the overall performance in the environmental domain was very good, with all scores above 80% for the pass category (Figure *8*).

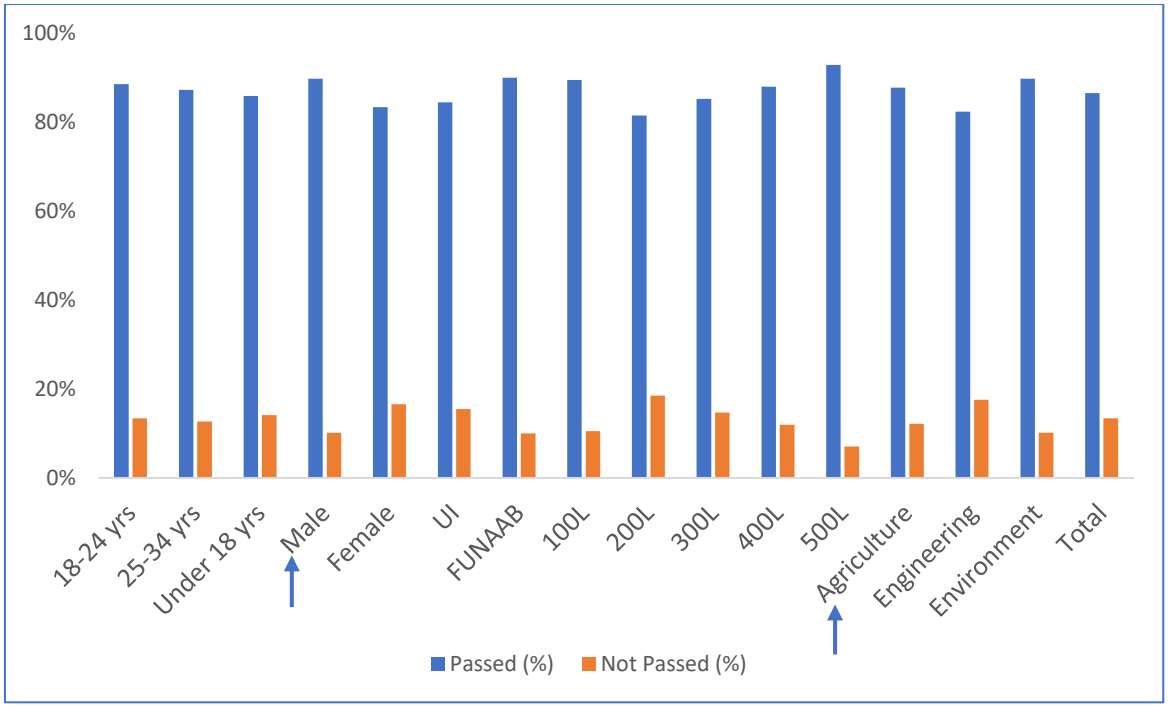

Figure 8. Performance on economics topics; Source: Author

The general performance on the social SLT domain was very low (Figure *9*); however, there was a statistical significance in *age* and *field of study* on social literacy of *P=0.020* and *0.006*. Similarly, here H9 is also accepted. 25-34 years and agriculture students performed better within their groups (Table 8).

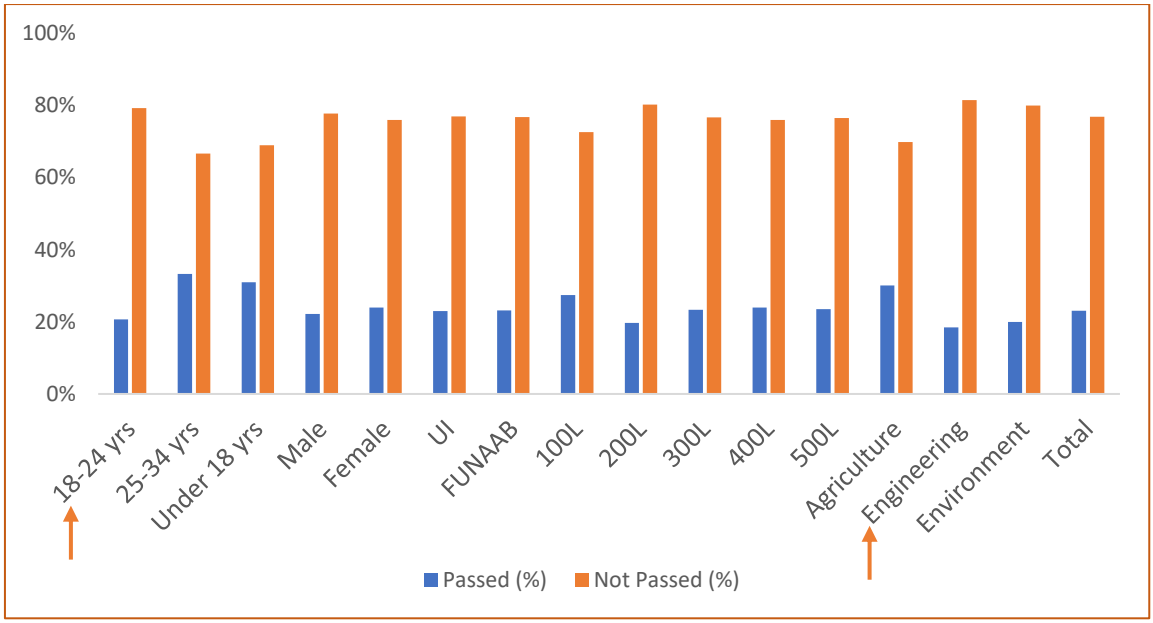

Figure 9. Performance on social topics; Source: Author

Like the economics domain, the performance on ESD knowledge was very good, with a high pass rate of 70% and above (Figure *10*). Furthermore, there was a statistical significance (*P=0.01*) between university groups with UI students performing better. As the other cases, H10 is also accepted, and the null hypothesis rejected (Table 8).

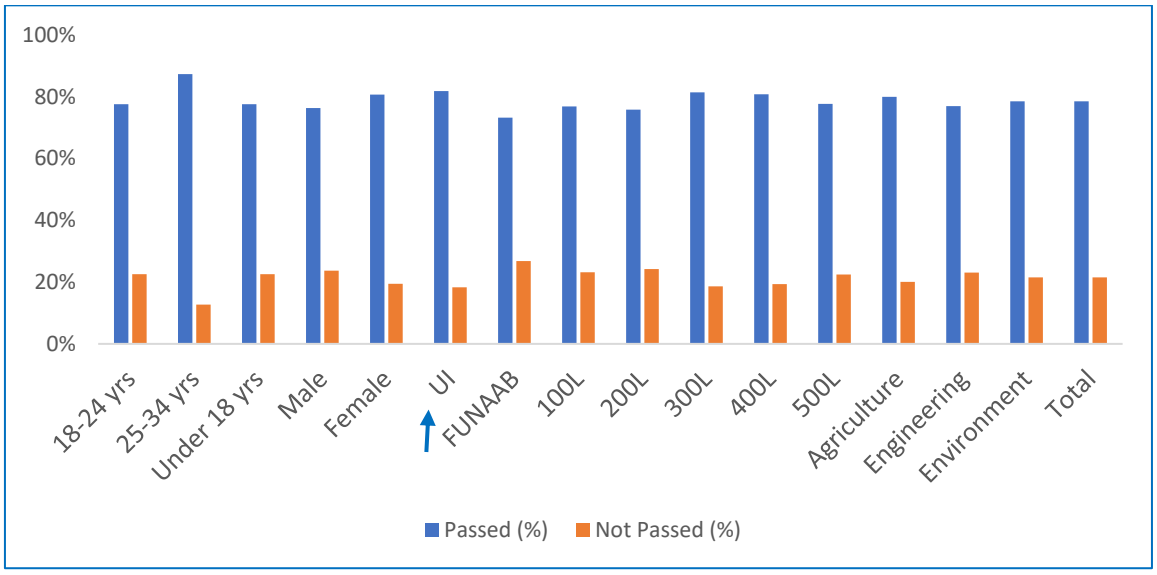

Figure 10. Performance on ESD topics; Source: Author

With the aggregated overall domain, the null hypothesis was also rejected as there was a statistical significance of *P=0.018* between *the study field*. Agriculture students were seen to perform better than the other students. However, the general overall performance was low as the pass criteria recorded its highest rate at 26.2%. Consequently, the SLT topics with high performance are the economic and ESD domains, whereas environment and social areas revealed lower literacy levels.

5.9. Overall Performance on the Sustainability Literacy Tests

As highlighted in the literature, the SLT allows for a way to assess the sustainability knowledge of individuals. This provision has been applied in this study to determine the level of environmental awareness of Nigerian students as one objective and to evaluate the overall sustainability literacy of young Nigerians as another goal. Nigerian students performed rather inadequately on the SLT assessment. The study found several statistical significances across certain demographic groups in all the SLT domains besides the environmental topics. Furthermore, agriculture students exhibited higher knowledge in the social and overall topics, followed by students in the environmental study field.

Even though there was no statistical significance found in the performance on environmental topics, surprisingly, students in environmental fields were not the best performers in environmental themes. However, they did better than engineering students. This is an unanticipated outcome as environmental students were included in this study with an optimism that they are more learned on environmental topics supposedly being taught in their curriculum. Therefore, it is important to highlight that environmental knowledge is very low among Nigerian students, and perhaps an

interposition into environmental curriculums in universities is needed. This need is further emphasised as the environmental theme recorded the least familiarity by the students.

Table 9. Results of multivariate analysis of variance of the SLT items against socio-demographics
(N=650)

Variables	P value	Partial ETA squared (η^2)
Environment domain		
Age	0.427	0.003
Gender	0.504	0.001
University	0.113	0.004
Study year	0.255	0.008
Study field	0.063	0.009
Economics domain		
Age	0.973	0.000
Gender	0.016*	0.009
University	0.045*	0.006
Study year	0.075	0.013
Study field	0.070	0.008
Social		
Age	0.020*	0.012
Gender	0.577	0.000
University	0.953	0.000
Study year	0.694	0.003
Study field	0.006*	0.015
ESD		
Age	0.200	0.005
Gender	0.182	0.003
University	0.010*	0.010
Study year	0.736	0.003
Study field	0.735	0.001
Overall		
Age	0.137	0.006
Gender	0.566	0.001
University	0.545	0.001
Study year	0.284	0.008
Study field	0.018*	0.012

*P < 0.05

Additionally, the students also performed just as poor in the social themes. However, the 100L or first-year students did better in their groups, as the study finds. A plausible reason for this is uncertain, but presumably, the initial piqued exploratory interests in students as they first gain university admission possibly begin to rescind as students continue in their study programs and begin to encounter more focused speciality.

On the upside, the ESD and economic topics revealed better performances associated with this domain. The student groups generally performed the same in these domains. However, a slight outperformance by students in the 25-34 years category on the ESD topic may be explained by said age group being at the end of their study and so more engaged with events or issues of a more contemporary disposition.

5.10. Comparison with Other Studies

The current study was inspired by two prior studies carried out by Zwickle et al. (2014) at Ohio State University and Akeel et al. (2019) on the Nigerian engineering community.

Similarly, to the study on Nigerian engineering students with a mean score of 20%, Nigerian university students recorded 21% on sustainability literacy, with a minuscule difference of 1%. This contrasts with the score of Ohio students' score of 69%, therefore resonating with Akeel's (2019) suggestion that Nigerian university students appear to be less knowledgeable.

In the environmental domain, Ohio students recorded 73% in this topic, whereas a distinct opposite of 5.8% is applicable for the Nigerian students. For instance, Q1 (Q1: Ozone layer protects us from acid rain and temperature fluctuations), which was

featured in both studies (Akeel et al., 2019; Zwickle et al., 2014), recorded only 6.6% of correct answers among Nigerian university students while Ohio state university students were said to have correctly answered this same question at a score of 92.1%. In addition, Nigerian engineering students in Akeel et al. (2019) study, even though they did not perform anywhere close to the Ohio students, still outperformed the students involved in our study at 10% to Q1. Similarly, the study evaluating Cypriot architectural students' environmental knowledge found that higher pass rates were derived by students from abroad, 92% of foreign students were able to answer the questions correctly, whereas 45 % of Cypriot students answered correctly (Asiloy et al., 2017).

Similarly, Yildirim et al. (2015) also discusses the link between education subjects and environmental awareness/ behaviour. Their study found that more university student in the health science study program showed more environmental knowledge than university students from natural and social science fields. However, this study reports that students in agriculture study programs showed better overall sustainability literacy than students in engineering or environmental study programs

Although it is evident that Nigerian students' environmental knowledge is lacking from this study, we recall that they performed better in economics and ESD domains. Nigerian students' performance regarding the economic domain revealed an 86.6% pass rate, while Ohio students had a 71% assessment score. Furthermore, Q6 (Q6: Long-term profitability is the most commonly used definition of economic sustainability), another question featured in both studies, shows Nigerian students with a higher assessment score of 64.5%, while Ohio students with 46.3%. Therefore, as recommended by Akeel et al. (2019), the presumption that sustainability literacy in advanced countries supersedes that of other regions will be a misstep; however, this

study still reveals that Nigerian students still have a vast opportunity for growth, especially with environmental and social knowledge.

Another distinction between this study and the research carried out in Ohio State University is seen in the results by study year. While there was no statistical significance across the study year for Nigerian students, first-year students performed better overall on the SLT. Similarly, in a Turkish study on university students in Ankara, when asked about the impacts of global warming, Oguz et al. (2010) did not find a significant correlation and overall low pass rates. Nonetheless, the 1st year students outperformed the 4th year students with 26.6 % to 19.1% correct answers, respectively. However, in contrast, the Ohio university students record a progression in sustainability knowledge as class rank (study year) increases.

Zsoka et al. (2013) reported a positive impact on behaviour after sustainability education. Furthermore, stating that a significant relationship between environmental education and environmental knowledge exists. In alignment to this statement, and a similarly conclusion by Sammalisto et al. (2016) that significant changes over time were found in students' knowledge, in contrast this study finds that as the study year progress, there is no significant increase in environmental knowledge. Similarly, Carmi et al. (2015) found a shortage in progressive environmental knowledge of students and a decrease in pro-environmental behaviour, values and attitudes moving through student's years in a green Israeli college.

In addition to the difference in class rank, the study field also presented interesting insights in the Ohio study as it did in this study. Since there was a selection of economics students in the Ohio study, the expected outcome expressed by Zwickle et al. (2014) was that they would perform better than other study fields on the economic domain; however, the economic students were outperformed by the aeronautical

engineering students. Additionally, Zhang et al. (2017) also found engineering students to perform less than agricultural students in evaluating environmental literacy amongst Chinese university students. This is a similar finding with Nigerian students in this study, where agriculture students scored higher than environmental students in the environment domain of the SLT, but the expectation was the reverse.

Consequently, this comparison aims not to pass judgment on brilliancy between students in advanced countries or developing nations. Nonetheless, it is mainly for informative and educational purposes to allow for more targeted education interventions to occur as needed. It can also further show priorities of government or society related to SD as to what topics are included in the courses and public like the media, for example.

This study finds many opportunities present themselves in the form of curriculum, policy making and research for universities to take advantage of in order to promote environmental sustainability just as discovered by Dagiliūtė and Liobikiene (2015). University roles towards sustainability has been around for more than a decade and more higher learning institutions have begun to incorporate sustainability into the learning curriculum uniquely, although many of them appear to do this on a need-to basis rather than consistently (Dagiliūtė et al., 2018; Sidiropoulos, 2018). Hence, the recommendation is that universities should be steadfast in their approach towards promoting environmental sustainability.

6. Conclusion and Recommendations

The significance of applying TPB as a foundation in understanding the underlying behaviour of Nigerian students towards plastic waste sorting intention can be seen through the results of this study. On a broader concept, this study demonstrates that *PBC* contributes more than subjective norms and attitudes in explaining why students may choose to sort their plastic waste or not. However, *attitude* was not found to be significant, whereas the *subjective norm* was.

The implication of the revelation from this study suggest that Nigerian students display lax believe that social norms dictate active plastic sorting behaviour, nonetheless, exhibit positive attitudes towards plastic sorting. It is still imperative to cultivate a stronger sense of their PBC for visible changes to be seen shortly with regards to more plastic waste sorting behaviours.

If more students adopt pro-environmental behaviours, there is an increased likelihood that these behaviours will be passed to their peers, siblings, and families — thus increasing the possibility of making the general public to shift from non-environmentally friendly behaviours to environmentally-friendly behaviours with many potential positive impacts on the environment on a broader scale.

Another important takeaway from this study is the need for more attention to be paid to students' attitudes, especially from developing countries concerning plastic waste sorting. Therefore, it is not enough for a student to exhibit a positive attitude to plastic recycling if it would not bring about the same positive impact on the actual intention to sort plastic waste. Furthermore, it is also necessary for government and policy makers to implement plastic waste reduction laws like bans on plastic bag use or importation of plastic products alongside improvement of plastic recycling and recovery efforts. In so doing, a culture of reduced use of plastic products will likely

become more evident both at individual and commercial levels, inherently leading to visible outcomes towards curbing plastic waste pollution.

Additionally, the types of plastic wastes mostly generated on campus are low density polyethylene e.g., plastic water bottles and plastic bags. A preventive suggestion is to promote the three R's (reduce, reuse and recycle) concept on campus and provide more sustainable alternatives such as more long-lasting shopping bags (Yeow et al., 2014). Raising awareness beyond the classroom and reaching vendors and policy makers will also prevent future creation of plastic waste on campus (Singh and Cooper, 2017). A similar recommendation was rendered by Susanto et al. (2019), stating that government should create awareness campaigns of 3R, to change negative perceptions of people's attitude and subjective norms towards the environment.

The study also demonstrates the necessity of including other influencing variables by looking into a student's university level, environmental curriculums, volunteering, and awareness which all exhibited statistical significance towards students' intentions to sort plastic waste. The study went further to assess other factors like gender and the source of environmental information. Even though these factors were not proven statistically significant, they might still be useful in another sample variant for other studies in determining their influences over the intentions of youth on plastic waste sorting.

Moreover, educators should promote practical-based environmental learning rather than theory-based environmental education (Teff-Seker et al., 2019; Tam, 2018). The former is more likely to lead to more pro-environmental behaviours. That is, students' environmental attitudes are acquired primarily by experience or practical but not by knowledge (Tam 2018).

Therefore, one primary recommendation for universities in Nigeria is to improve their extracurricular activities related to environmental behaviour as over 80% of the student sample population currently do not belong to an environmental volunteering initiative within or outside the university. These initiatives could include hands-on training or internships for students by collaborating with FEPA, SEPA or other environmental agencies in the region where students can gain more knowledge and awareness on recycling and other pro-environmental behaviours.

Another recommendation is for more universities to take the initiatives themselves by starting with something as simple as placing recycling bins around the university premises and encouraging students to sort plastic waste to recycle and take part in other forms of solid waste recycling practices.

Consequently, this study is justified by its contribution to similar case studies but carries further and could be replicated by other researchers studying youths' pro-environmental behaviour in different global regions. In addition to this paper's contribution to limited studies of this type in emerging countries, this study highlights the use of the TPB. This topical theoretical model has only been carried out minimally by similar research in developing countries.

The study also assessed sustainability literacy to evaluate Nigerian students environmental and sustainability knowledge. Cultivating and improving sustainability knowledge is a common goal for educators. The study finds that Nigerian students still have a lot of opportunities for growth and improvement in environmental sustainability knowledge.

Environmental questions featured in this SLT assessment included critical aspects of global environmental concerns on climate change; however, the poor performance of students in these topics shows the need for more focused interventions into

environmental programmes and curriculum in universities. Furthermore, the benefits of environmental knowledge are widely acclaimed globally; hence it is in the best interests of Nigeria to facilitate educational interventions not only at HEIs but throughout the education system.

Nigerian students showed considerable knowledge of economic and crosscutting ESD topics. However, as the social and environmental domains demonstrated an inverse knowledge, it highlights an imbalance needed to ascertain sustainable development. Hence, for sustainable development in education to be managed, it needs to ensure all tiers of sustainability – environment, social and economic - are embraced equally. Furthermore, overall sustainability literacy also demonstrates poor awareness levels amongst Nigerian students, which provides another opportunity for improvement and directly impacts policymakers, especially in the educational system.

The findings from this study also address recommendations to educators and university bodies on the necessity of continued environmental and sustainability education throughout the study year progression. It is essential that students remain environmentally focused or driven until the point of graduation to produce invaluable members of society with sustainable development at the core of their decision-making goals.

Finally, this study strongly recommends that HEIs in Nigeria and other universities globally take advantage of the abundance of a sustainability assessment tool such as Sulitest.org, ASK or various others and implement these tools. Periodic assessment using the SLT measures will help HEIs identify and focus their sustainability programmes for the development of students as well as educators.

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8. APPENDICES

Appendix A: SLT Questionnaire structure (N=650)

Question	SLT focus area	Answer type
Q1	Environmental	Multiple choice
Q2	ESD	Multiple choice
Q3	ESD	Multiple choice
Q4	Environmental	Multiple choice
Q5	Social	Multiple choice
Q6	Economic	Multiple choice
Q7	Economic	Multiple choice
Q8	Environmental	Multiple choice
Q9	Social	Multiple choice
Q10	Environmental	Multiple choice
Q11	Economic	Multiple choice
Q12	Environmental	Multiple choice
Q13	Social	Multiple choice
Q14	Environmental	Open-ended
Q15	ESD	Multiple choice

Appendix B – Characteristics of SLT questions (correct answer in bold; N=650)

SLT questions	Multiple choice options	References
Q1. Ozone layer protects us from acid rain and temperature fluctuations.	True/**False**/I don't know	Akeel et al. (2019) adapted from Zwickle et al. (2014) (ASK)
Q2. Economic development and environmental protection are independent of each Other.	True/**False**/I don't know	Akeel et al. (2019)
Q3. Sustainable development has 3 pillars, social, economic, and environmental pillar(s). Which of these has the most innovative potential to combine sustainable practices, technology, and money-making tools?	○ Social pillar ○ **Economic pillar** ○ Environmental pillar ○ I don't know	Sulitest®
Q4. IPCC stands for	○ The international policy on climate change ○ The intergovernmental policy on climate change ○ **The intergovernmental panel on climate change** ○ I don't know	Sulitest®

Q5. Agenda 21 is a global treaty signed by UN member nations at the Stockholm Earth Summit in 1992.	True/**False**/I don't know	Akeel et al. (2019)
Q6. Long-term profitability is the most commonly used definition of economic sustainability.	**True**/False/I don't know	Akeel et al. (2019) adapted from Zwickle et al. (2014) (ASK)
Q7. Less than one million people in the world have NO access to clean drinking water.	True/**False**/I don't know	Akeel et al. (2019)
Q8. Carbon monoxide is one of the greenhouse gases that causes global warming.	True/**False**/I don't know	Akeel et al. (2019)
9. In 1900 global population stood at	o 1.4 Billion o 1.5 Billion o **1.6 Billion** o I don't know	Adapted from Akeel et al. (2019)
Q10. Which of these does NOT contribute to greenhouse effect?	o **Nitrous dioxide** o Methane o Chlorofluorocarbon o Water vapour o I don't know	Sulitest®

Q11. Many countries became independent and joined the United Nations as a result of decolonization.	**True**/False/I don't know	Sulitest®
Q12. Federal Environmental Protection Agency is the primary agency that oversees environmental regulation in Nigeria.	True/**False**/I don't know	Akeel et al. (2019) adapted from Zwickle et al. (2014) (ASK)
Q13. The internationally agreed poverty line is	**$ 1.90**, $1.80, $ 1.70 I don't know	Adapted from Akeel et al. (2019)
Q14. The Nigerian Act which allows each State and Local Government in the country to set up its own agency for protection and improvement of the environment within the state is	**NESREA**	Sulitest®
15. Widely accepted perception of sustainability pillars views the relationship between social, environment and economic to be	o Hierarchal o **Equal** o I don't know	Adapted from Akeel et al. (2019)

Introduction to the questionnaire

- Thank you for participating in this study.
- The results from this study will be used for research on environmental awareness and pro-environmental behaviour of young Nigerians.
- The Last section contains an 'awareness test' that will not be graded, and the author of this questionnaire will appreciate if you only put down what comes to mind throughout the filling process of the questions in all sections.
- There is no need to ask friends, use internet or other resources until after you have kept down your own opinions of all the questions.
- Your identities will remain anonymous as it is not needed for this study. - Thanks again for your cooperation

PART A-PEB

Please read each question carefully and answer each of the following questions by circling the number that best describes your opinion, some questions may appear similar, but they address slightly different issues

(1,7) Extremely/strongly (2,6) quite (3,5) slightly (4) neither

1. 1. For me, improving environmental sanitation by plastic recycling is

	1	2	3	4	5	6	7	
Extremely bad	◯	◯	◯	◯	◯	◯	◯	Extremely good

2. 2. For me to spend my effort gathering plastic for recycle is

	1	2	3	4	5	6	7	
Extremely bad	◯	◯	◯	◯	◯	◯	◯	Extremely good

3. 3. For me to make money from plastic recycling is

	1	2	3	4	5	6	7	
Extremely bad	◯	◯	◯	◯	◯	◯	◯	Extremely good

4. 4. For me to take out time from leisure or other activities to recycle plastic is

	1	2	3	4	5	6	7	
Extremely bad	◯	◯	◯	◯	◯	◯	◯	Extremely good

5. 5. My classmates will approve if they see me gathering plastic for recycling

	1	2	3	4	5	6	7	
strongly disagree	◯	◯	◯	◯	◯	◯	◯	strongly agree

6. 6. People I look up to will be pleased to see me gather plastic for recycling

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

7. 7. My friends always separate plastic from other wastes for recycling

	1	2	3	4	5	6	7	
Extremely unlikely	◯	◯	◯	◯	◯	◯	◯	Extremely likely

8. 8. People I look up to will be expect me to separate plastic for recycling

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

9. 9. There are several opportunities around me for plastic recycling if I choose to do so

	1	2	3	4	5	6	7	
Extremely unlikely	◯	◯	◯	◯	◯	◯	◯	extremely likely

10. 10. Nothing prevents me from recycling my plastic regularly

	1	2	3	4	5	6	7	
strongly disagree	◯	◯	◯	◯	◯	◯	◯	strongly agree

11. 11. I am very confident that I can gather plastic for recycling if I choose to do so

	1	2	3	4	5	6	7	
strongly disagree	◯	◯	◯	◯	◯	◯	◯	strongly agree

12. 12. For me to travel long distance to a recycle centre for the sake of plastic recycling is

	1	2	3	4	5	6	7	
Extremely bad	◯	◯	◯	◯	◯	◯	◯	Extremely good

13. 13. I will commence plastic recycling from now on

	1	2	3	4	5	6	7	
Extremely unlikely	◯	◯	◯	◯	◯	◯	◯	Extremely likely

14. 14. How many times have you separated your plastic waste for recycling in the past 2 weeks?

_____

PART B

- PEA

- Please chose the correct answer according to your knowledge.
- The scores on this test do not affect your real courses, however the results used to facilitate research on environmental awareness and knowledge of young elite Nigerians.
- Please avoid guessing; instead choose or write down 'I don't know' were applicable.
- The test should take approximately 10 – 15mins to complete.

Thank you for participating

15. 1. Ozone layer protects us from acid rain and temperature fluctuations

- ◯ True
- ◯ False
- ◯ I don't know

16. 2. Economic development and environmental protection are independent of each other

- ◯ True
- ◯ False
- ◯ I don't know

17. 3. Sustainable development has 3 pillars, social, economic and environmental pillar(s). Which of these has the most innovative potential to combine sustainable practices, technology and money-making tools?

	social pillar	Economic pillar	environmental pillar	I don't know
choose one	◯	◯	◯	◯

18. 4. IPCC stands for

- The international policy on climate change
- The intergovernmental policy on climate change
- The intergovernmental panel on climate change
- I don't know

19. 5. Agenda 21 is a global treaty signed by UN member nations at the Stockholm Earth Summit in 1992

- True
- False
- I don't know

20. 6. Long-term profitability is the most commonly used definition of economic sustainability

- True
- False
- I don't know

21. 7. Less than one million people in the world have NO access to clean drinking water

- True
- False
- I don't know

22. 8. Carbon monoxide is one of the greenhouse gases that causes global warming

- ◯ True
- ◯ False
- ◯ I don't know

23. 9. In 1900 global population stood at

	1.4 billion	1.5 billion	1.6 billion	I don't know
choose one	◯	◯	◯	◯

24. 10. Which of these does NOT contribute to greenhouse effect?

	Nitrous dioxide	Methane	Chlorofluorocarbon	Water vapour	I don't know
choose one	◯	◯	◯	◯	◯

25. 11. Many countries became independent and joined the United Nations as a result of decolonization

- ◯ True
- ◯ False
- ◯ I don't know

26. 12. Federal Environmental Protection Agency is the primary agency that oversees environmental regulation in Nigeria

- ◯ True
- ◯ False
- ◯ I don't know

27. 13. The internationally agreed poverty line is

	$ 1.90	$ 1.80	$ 1. 70	I don't know
(us dollars per day)	◯	◯	◯	◯

28. 14. The Nigerian Act which allows each State and Local Government in the country to set up its own agency for protection and improvement of the environment within the state is

_____

29. 15. Widely accepted perception of sustainability pillars views the relationship between social, environment and economic to be

	Hierarchal	Equal	I don't know
choose one	◯	◯	◯

Part C

30. 1. age

	under 18	18-24	25-34	35 and above
age range	◯	◯	◯	◯

31. 2. Gender

◯ Male

◯ Female

32. 3. Name of University

_____

33. 4. University level

	1	2	3	4	5
year	◯	◯	◯	◯	◯

34. 5. Faculty

_____

35. 6. I always follow environmental news

◯ Yes

◯ No

36. 7. I am a member of a voluntary environmental organization

- Yes
- No

37. 8. Main source of environmental information

- University
- Both
- Media

Curriculum Vitae and Publications

Date of birth: June 18, 1991
Place of birth: Nigeria
Address: Hybernská 1010/26, Praha 1, 11 000, Czechia
Email: Aikowel@ftz.czu.cz

Education

- 2018 - Present PhD., Sustainable Rural Technologies

University: Czech University of Life Sciences, Prague
Faculty: Tropical Agriculture
Thesis: "Pro-environmental Awareness of University Students – Assessment through Sustainability Literacy Test"

- 2015-2016 M.Sc., Risk, Disaster and Environmental Management

University: Huddersfield University, United Kingdom
Faculty: Management Studies
Thesis: "Youth Participation and Awareness on Climate Change: A Survey on Developing Countries"

- 2008-2012 B.Sc., Zoology

University: Lagos State University, Nigeria
Faculty: Environmental Science
Thesis: "Effect of Shell Thickness on Quail Chick Break Out at Hatching."

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- Journal Publication in Q2 with Impact Factor 2.854 - Aikowe LD, Mazancová J. Pro-environmental Awareness of University Students – Assessment through Sustainability Literacy Test. International Journal of Sustainability in Higher Education. 2022; In Review
- Other publication - Aikowe LD. Environmental Awareness and Plastic Recycling Behaviour of Nigerian Undergraduates. *Envigogika.* 2021

Conference Contributions:

- 21st September 2019 Tropentag Conference

Kassel, Germany
Poster: "Pro-environmental Awareness of Nigerian Youths"

- 16th of November 2019

Euro League for Life Sciences Conference
Uppsala, Sweden
Poster: "Pro-environmental Behaviour of Nigerian Youths: Barriers to Plastic Recycling"


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