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Campus Green Infrastructures and Academic Performance in Tertiary Institutions in Nigeria's South West

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The concept of campus green infrastructure has been gaining attention in recent years as a potential solution for enhancing the learning environment and improving the academic performance of students in tertiary institutions. Despite the growing interest in the provision of green infrastructure on campuses, there is a lack of empirical evidence on the impacts of these infrastructures on students' academic performance and well-being in Nigerian tertiary institutions, particularly in the South-West region of the country. Thus, this study aims to examine the impacts of campus green infrastructures on enhancing the learning environment and improving students' academic performance in tertiary institutions in South-West, Nigeria. The research employed a descriptive survey design, using quantitative research approach to gather data from 398 students from two tertiary institutions in South-West, Nigeria. Data were collected through structured questionnaires, and analyzed by SPSS version 24. The results revealed that campus green infrastructures have a significant positive impact on a student's academic performance and well-being of the students with significant values of $p < 0.05$ for all the variables. The study also revealed that green spaces on campus provided a conducive environment for learning and improved students' mental health. Additionally, the study showed that the Campus Green Infrastructures could be optimized by incorporating comfortable seating elements, proper arrangement of space, and provision of lighting and other features. All these are associated with higher levels of academic engagement, motivation, and satisfaction among students. The study concludes that the provision of campus green infrastructures is crucial for enhancing the learning environment and improving students' academic performance in tertiary institutions. The findings of this study have implications for policymakers and university administrators in South-West, Nigeria, who can utilize this knowledge to improve the quality of education and overall well-being of students in their institutions.

Keywords: Campus green infrastructure; Learning environment; Academic performance; Tertiary institutions; Nigeria

INTRODUCTION

The provision of campus green infrastructure has become an increasingly popular trend among tertiary institutions worldwide. Campus Green infrastructure refers to the natural and built systems that provide a range of ecological, economic, and social benefits (Oyeyoade & Araloyin, 2019; Adeleke, et. al., 2018). These systems include green spaces, parks, gardens, trees, and water bodies, among others. The importance of campus green infrastructure has been linked to its ability to enhance the learning environment and improve students' academic performance and well-being (Abu-Ghazzeh, 1999; Agboola et. al., 2020). In view of this, tertiary institutions in Nigeria are facing increasing pressure to provide a conducive learning environment for students. The high demand for quality education and the need to attract students from various regions of the country and beyond have led to an increase in campus green infrastructure development (Liu et. al., 2022).

The poor status of the campus landscape environment has negatively impacted the students' activities and academic performance (Biddulph, 1999; Farombi, 1998). In addition, the impacts of climate change coupled with land-use change have

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brought serious challenges to maintaining institutions' landscape planning services (Freiberg, 1998; Lester & Akande,1995; Aydin & Ter, 2008). Tertiary institutions in Nigeria are under pressure to provide a conducive learning environment for students, given the high demand for quality education and the need to attract students from various regions of the country and beyond. One way of creating such an environment is through the development of campus green infrastructures. While campus green infrastructure development has become a popular trend among tertiary institutions worldwide, the potential benefits of this trend have not been adequately studied in Nigerian tertiary institutions, particularly in the South-West region of the country.

Despite the growing recognition of the importance of campus green infrastructure, there is a lack of empirical evidence on the potential impacts of campus green infrastructures on students' academic performance and well-being in Nigerian tertiary institutions. This lack of empirical evidence limits the ability of policymakers and university administrators to make informed decisions on the development of campus green infrastructures to enhance the learning environment and improve students' academic performance in tertiary institutions. Furthermore, the limited research that exists on the impacts of campus green infrastructures on students' academic performance and well-being in Nigerian tertiary institutions has primarily focused on institutions in other regions of the country. Therefore, there is a need to investigate the potential impacts of campus green infrastructures on students' academic performance and well-being in tertiary institutions in the South-West region of Nigeria, which has unique environmental and socio-economic characteristics.

The concept of campus green infrastructure development is gaining attention in Nigeria, as some tertiary institutions have been encouraging the incorporation of green infrastructure into their campuses. However, the current trend toward campus green infrastructure development necessitated for empirical evidence to support the initiatives. This is with a view of enhancing a conducive learning environment for students' academic performance. Research has shown that the physical environment has a significant impact on a student's academic performance and well-being. A conducive learning environment supports students' academic and personal growth, and green infrastructures have been identified as a critical component of such an environment. In addition to enhancing the learning environment, campus green infrastructure has also been linked to the well-being of students. The presence of green infrastructures on campuses has been shown to reduce stress levels, improve mental health, and promote physical activity among students. These benefits have been attributed to the ability of green infrastructures to provide a sense of calm and relaxation, which is essential for academic success.

The need for empirical evidence on the impacts of campus green infrastructures on students' academic performance and well-being in Nigerian tertiary institutions cannot be overstated. While some studies have been conducted in other countries, there is a lack of empirical evidence on the potential benefits of campus green infrastructures in Nigerian tertiary institutions, particularly in the South-West region of the country. This study aims to fill this gap by examining the impacts of campus green infrastructures on enhancing the learning environment and improving students' academic performance in tertiary institutions in South-West, Nigeria.

Specifically, the study seeks to answer the following research questions:

(i) What is the relationship between campus green infrastructures and students' academic performance in tertiary institutions in South-West, Nigeria?
(ii) What is the relationship between campus green infrastructures and students' well-being in tertiary institutions in South-West, Nigeria?
(iii) How can campus green infrastructures be optimized to enhance the learning environment and improve students' academic performance in tertiary institutions in South-West, Nigeria?

By answering these research questions, the study will provide empirical evidence on the potential impacts of campus green infrastructures on students' academic performance and well-being in tertiary institutions in South-West, Nigeria. This evidence will be useful to policymakers and university administrators in the region, as it will inform the development of policies and strategies to enhance the learning environment and improve students' academic performance in tertiary institutions.

The study's scope is limited to selected tertiary institutions in the South-West region, due to constraints in terms of time and resources. The selected tertiary institutions are those that have existing green infrastructures and the study focuses on undergraduate students in these institutions. The findings of this study have implications for policymakers and university administrators in South-West, Nigeria, who can utilize this knowledge to improve the quality of education and overall well-being of students in their institutions. The study also contributes to the existing body of knowledge on the importance of green infrastructure development on campus and its potential impact on student's academic performance and well-being. This manuscript is divided into three sections, namely: Section 1 presents the introduction to the research title; Section 2 dwelt with the review of pieces of literature on the important keywords such as the existing literature on the relationship between campus green infrastructures and academic performance, focusing on studies conducted in tertiary institutions in South-West, Nigeria among others. Section 3, presented the study's methodology, including the data gathering, analysis, results, and findings. Section 4 sums up the study's conclusion, recommendation, and implication.

LITERATURE REVIEW

Green infrastructures

Green infrastructures are defined as natural and semi-natural systems that provide ecological, social, and economic benefits to communities (Benedict & McMahon, 2006). Campus green infrastructures are green spaces, such as parks, gardens, and lawns, on college and university campuses (Tang, et. al., 2018; Browning & Rigolon (2019). The development of green infrastructures in tertiary institutions has become increasingly popular globally due to their potential benefits, including improved academic performance and well-being of students, enhanced biodiversity, and reduced ecological footprint (Mell, 2010; Aristovnik, et. al., 2020). Several studies have examined the impacts of campus green infrastructures on students' academic performance and well-being.

A study by Kweon et al. (2017) found that students who had access to green spaces on their campus had lower stress levels and improved academic performance compared to those without access to green spaces. Similarly, a study by Liu et al. (2022) found that students who had access to green spaces on their campus reported higher levels of well-being and satisfaction with their living environment. Green infrastructures have also been found to enhance biodiversity and reduce the ecological footprint of tertiary institutions. A study by Finlay, & Massey, (2012); found that green infrastructures on university campuses provided habitats for a variety of plant and animal species, and also helped to reduce the carbon footprint of the institution by sequestering carbon dioxide. Similarly, a study by Partridge, & Clark, (2018); found that green roofs reduced energy consumption and provided habitats for birds and insects.

Despite the potential benefits of green infrastructures, their development and maintenance in tertiary institutions are often constrained by various factors. A study by Jim, (2017) identified factors such as lack of funding, lack of awareness, and institutional policies and regulations as barriers to the development and maintenance of green infrastructures in tertiary institutions. Another study by Young, (2011); found that inadequate maintenance of green infrastructures, including lack of water, pruning, and pest control, could reduce the effectiveness of these infrastructures in providing their potential benefits. In Nigeria, the development of green infrastructures in tertiary institutions is still in its infancy, and there is limited empirical evidence on the impacts of these infrastructures on students' academic performance and well-being. However, there have been some efforts towards the development of green infrastructures in tertiary institutions in Nigeria. For example, a study by Adeleke, et.al., (2018) and Emmanuel, & Olufemi, (2017);identified some existing green infrastructures, including lawns, gardens, and parks, in selected Nigerian universities. The study also highlighted the potential benefits of green infrastructures in tertiary institutions, including improved aesthetics, reduced stress levels, and enhanced biodiversity (Mell, 2010 & 2017)

The benefits of campus green infrastructures go beyond just improving students' academic performance and well-being. Green infrastructures have also been found to improve air and water quality, reduce noise pollution, and provide social and recreational opportunities (Oyeyoade, & Araloyin, 2019; Emmanuel, & Olufemi, 2017). A study by Lee and Maheswaran (2011) and Barton & Rogerson, 2017); found that living near green spaces was associated with improved mental health and reduced mortality rates. Despite the potential benefits of green infrastructures, their development and maintenance requires careful planning and management. A study by Filazzola, e. al., (2019); identified several factors that influence the success of green infrastructure projects, including stakeholder engagement, site selection, design, and maintenance. The study emphasized the importance of involving local communities in green infrastructure planning and management to ensure their long-term success.

In the context of tertiary institutions, green infrastructures can also serve as educational resources for students. A study by Leal, et. al., (2018) and Browning & Rigolon (2019); found that green infrastructure projects on university campuses provided opportunities for experiential learning and research, and also contributed to the development of sustainability literacy among students. In Nigeria, there have been some efforts toward the development of green infrastructures in tertiary institutions, although these efforts are still in their early stages. For example, a study by Gholampour, et. al., (2022); reported on the development of a green roof system in developing countries, which provided several benefits, including reduced energy consumption and improved aesthetics. However, the study also highlighted the need for proper maintenance and management of the green roof to ensure its long-term effectiveness.

Cultural attitudes toward green spaces and environmental issues, as well as inadequate public awareness and education, are factors that may hinder the success of green infrastructure projects in Sub-Saharan Africa such as Nigeria (Du et. al., 2018; Adegun, (2017). Overall, the literature suggests that campus green infrastructures have the potential to provide multiple benefits to tertiary institutions, including improved academic performance and well-being of students, enhanced biodiversity, and reduced ecological footprint. However, their development and maintenance requires careful planning, management, and stakeholder engagement. The literature also highlights the need for further research on the impacts of campus green infrastructures in Nigerian tertiary institutions and the cultural and social factors that may influence their success.

The concept of campus green infrastructures

Green Infrastructure refers to both natural and semi-natural spaces and components in urban areas that consist of parks, gardens, and urban forests which offer a variety of environmentally friendly, interpersonal, and economic benefits. (Benedict & McMahon, 2006; Olumuyiwa et. al., 2021). In recent years, there has been growing interest in the potential of GI to enhance human health and well-being, including its effects on academic performance among students. Campus green infrastructures are unique in that they are specifically designed for and located within the confines of a college or university campus. These spaces can range from small-scale projects, such as community gardens or rain gardens, to larger-scale initiatives, such as urban forests or green roofs. The design and management of campus green infrastructures, typically involve a combination of hard and soft engineering techniques, including stormwater management practices, green roofs, green walls, urban forestry, and community gardens. These features are designed to enhance the ecological, social, and economic sustainability of the campus, while also providing opportunities for experiential learning and research. The ecological benefits of campus green infrastructures include improved air and water quality, enhanced biodiversity, and carbon sequestration.

Campus green infrastructures also provide social benefits to students, faculty, and staff. These spaces can promote mental and physical health, provide opportunities for socialization and recreation, and enhance the aesthetic appeal of the campus. Past literatures have shown that exposure to nature can reduce stress and anxiety, improve cognitive function, and enhance overall well-being (Kuo and Sullivan, 2001; Kim, et. al., (2021).In addition to the ecological and social benefits, campus green infrastructures can also provide economic benefits to the institution. For example, green roofs and walls can help to reduce heating and cooling costs, while community gardens can provide fresh produce for campus dining facilities. Campus green infrastructures can also serve as a marketing tool, attracting prospective students and faculty who value sustainability and environmental stewardship (Browning & Rigolon, 2019).

The design and management of campus green infrastructures require a multidisciplinary approach, involving

landscape architects, ecologists, engineers, and social scientists. The process typically involves a site assessment to identify opportunities and constraints, followed by the development of a design and management plan that addresses the goals and objectives of the institution. Implementation of the plan often requires collaboration with various stakeholders, including facilities management, academic departments, and student groups. Summarily, the concept of campus green infrastructures represents an innovative approach to enhancing the ecological, social, and economic sustainability of college and university campuses. These spaces can provide multiple benefits to the institution and its occupants, while also providing opportunities for experiential learning and research. The design and management of campus green infrastructures require careful planning and collaboration, but can ultimately lead to a more resilient and sustainable campus community.

Other benefits of campus green infrastructures is the enhancement of ecological sustainability. Many campuses have significant impervious surfaces, such as parking lots and buildings, which can contribute to runoff and water pollution. By incorporating green infrastructure, campuses can mitigate these impacts by capturing and filtering stormwater, reducing the urban heat island effect, and improving air quality. Green roofs, for example, can reduce the amount of heat absorbed by buildings, reducing the demand for air conditioning during the summer months. Additionally, campus green infrastructures can provide habitat for wildlife and promote biodiversity conservation. Campus green infrastructures also provide social benefits to students, faculty, and staff. These spaces can promote mental and physical health by providing opportunities for exercise and stress reduction, as well as enhancing the aesthetic appeal of the campus.

Research has shown that exposure to nature can have positive impacts on mental health, reducing stress and anxiety, improving cognitive function, and enhancing overall well-being (Kuo & Faber, 2004; Kim, et. al., (2021). Additionally, campus green infrastructures can serve as social gathering spaces, fostering community building and providing opportunities for student engagement and activism. The economic benefits of campus green infrastructures are also significant. Green roofs and walls can help to reduce heating and cooling costs, while community gardens can provide fresh produce for campus dining facilities (Partridge & Clark 2018).

Additionally, campus green infrastructures can serve as a marketing tool, attracting prospective students and faculty who value sustainability and environmental stewardship. Despite the many benefits of campus green infrastructures, there are also some challenges and limitations. These can include issues related to funding, maintenance, and site-specific constraints such as soil quality or space availability. Additionally, there may be competing priorities or conflicting goals within the institution that could impede the adoption of green infrastructure practices. Nevertheless, with careful planning, collaboration, and support from key stakeholders, campus green infrastructures can provide a range of benefits to colleges and universities, as well as to the broader community.

THE THEORETICAL FRAMEWORK AND THE HYPOTHESIS DEVELOPMENT

The theoretical framework for this study is based on the concept of social-ecological systems (SES), which emphasizes the interconnectedness of social and ecological systems (Masterson, et. al., 2017 Ibrahim, et.al., 2021). The SES framework recognizes that human activities and natural systems are deeply interlinked, and the ability of social and ecological systems to adapt and evolve in response to changing environmental conditions (Reyers, et. al., 2018; Ibrahim, et.al., 2021). The SES framework is particularly relevant to the study of campus green infrastructures, as these spaces are located within complex social-ecological systems. Campus green infrastructures are not isolated from the surrounding environment; rather, they are influenced by a range of factors, including land use patterns, and social dynamics. By adopting an SES framework, this study seeks to understand how campus green infrastructures can be managed to enhance ecological sustainability, promote social well-being, and support the academic mission of the institution (Biggs, et. al., 2021; Cambridge, 2020).

The SES framework also emphasizes the importance of governance and institutional arrangements in shaping social-ecological systems. Institutions, including colleges and universities, play a key role in shaping the behavior of actors within the system, influencing the allocation of resources, and establishing norms and values that shape social and ecological outcomes. By adopting policies and practices that promote sustainability, institutions can play a critical role in shaping the future of campus green infrastructures. This theoretical framework for this study seeks to understand how campus green infrastructures can be managed to promote students' well-being and their academic development.

In terms of hypothesis testing; this quantitative research helps to determine the statistical significance of relationships between variables. In the context of the impacts of campus green infrastructures on student academic performance, hypothesis testing is used to determine whether the relationships between green space and academic performance are statistically significant. Thus, based on the literature review and the conceptual model, four hypotheses are proposed:

(i) **H1**. The students' contact with Campus Green Infrastructure will be positively associated with students' academic performance in the two tertiary institutions in South-West, Nigeria.
H0. There is no significant difference in the mean response of students from OSCOTECH, Esa-Oke, and IRE-Polytechnic on the impacts of Campus Green Infrastructure on students' academic performance.

(ii) **H2**. The exposure to Campus Green Infrastructure on campus will be positively associated with students' well-being in the two tertiary institutions in South-West, Nigeria
H0. There is no significant difference in the mean response of students from OSCOTECH, Esa-Oke, and IRE-Polytechnic on the exposure to Campus Green Infrastructure on campus and the student's well-being.

(iii) **H3**. Optimized Campus Green Infrastructure will be positively associated with and improve students' academic performance in tertiary institutions in South-West, Nigeria.
H0. There is no significant difference in the mean response of students from OSCOTECH, Esa-oke, and IRE-Polytechnic on the optimization of the Campus Green Infrastructure to improve students' academic performance.

Interrelationships between the campus green infrastructures and academic performance

Previous studies have shown a strong link between campus green infrastructures and academic performance, indicating that these spaces have the potential to positively impact student learning outcomes. A growing body of literature revealed that the quality of Campus Green Infrastructures (CGI) in landscape planning is associated with students' academic performance (Rout, & Galpern, 2022; Marcus and Wischemann, 1990; Oyeyoade, & Araloyin, 2019). The functionaries and exhilarating experiences of a campus user were regarded as the contributory desired qualities for a good institutional landscape plan (Farombi, 1998; Freiberg, 1998; Osuji, et. al., (2020). Similarly, availability, aesthetic attraction, suitability for the realization of activities, safety, variety of use, and convenience form parts of the principle of a good campus' spatial quality (Marcus and Wischemann, 1990).

Focusing on Nigeria, similar other studies have investigated the impact of campus green infrastructures on student academic performance in South-West, Nigeria. A study by Adegun et al. (2019) found that students who had access to green spaces on campus had higher academic achievement than those who did not. The study also found that students who spent more time in green spaces had better cognitive functioning and higher levels of academic engagement. Similarly, a study by Browning & Rigolon (2019) found that students who spent time in campus green spaces had higher levels of academic performance and were more likely to stay in school. Other studies have examined the impact of specific types of green spaces on academic performance. For example, a study by Wassenberg, et. al., (2015);Su, & Cheng, (2015); investigated the effect of a campus botanical garden on student learning outcomes. The study found that students who had regular access to the garden had higher levels of academic achievement, as well as improved critical thinking and problem-solving skills.

Studies have also examined the relationship between campus green infrastructures and student well-being. A study by Kim, et. al., (2021) and Kuo and Sullivan, (2001) found that students who had access to campus green spaces reported lower levels of stress and higher levels of life satisfaction. The study also found that students who spent time in green spaces were more likely to engage in physical activity, which can have a positive impact on academic performance. While the existing literature suggests a positive relationship between campus green infrastructures and academic performance, some studies have found mixed results. For example, a study by Kim, et. al., (2021); and Browning & Rigolon (2019) found that while campus green spaces had a positive impact on student well-being, there was no significant relationship between green spaces and academic performance. Similarly, a study by Adekunle et al. (2013) found that while students who had access to green spaces reported higher levels of academic engagement, there was no significant difference in academic achievement between students with and without access to green spaces.

It is worth noting that several factors can influence the relationship between campus green infrastructures and academic performance. For example, the type and design of green spaces, the frequency and duration of exposure, and the characteristics of the student population can all play a role. Additionally, the presence of other environmental stressors, such as noise and air pollution, can mitigate the positive effects of green spaces. Overall, the existing literature suggests that campus green infrastructures can have a positive impact on student academic performance and well-being. While some studies have found mixed results, the majority of studies have found a positive relationship between green spaces and academic performance. However, further research by Agboola et. al., (2020; 2021) revealed the relationships between the college undergraduate student and outdoor space study. The research statistically established the significance of outdoor space's familiarity, identity, dependence, and outdoor space utilization as important variables in the campus environment, that contributes positively to the student's social relationship and utilization in South-west, Nigeria.

The Relationship between campus green infrastructures and Student Well-being

A wide range of literature has been studied, including a series on the effects of green spaces on the psychological well-being of students in higher institutions in South-West Nigeria. Similarly, multiple studies have found that green environments improve the well-being of students. Other studies have focused on specific types of green spaces and their impact on student well-being. For example, a study by Foellmer, et. al., (2021); Adebayo et al. (2013); explored the impact of a campus green park on student well-being. The study found that students who had access to the park reported lower levels of stress and higher levels of life satisfaction and perceived health. The study also found that students who spent more time in the park were more likely to engage in physical activity and had higher levels of social connectedness. Another study by Wassenberg, et. al., (2015; Fan, et. al., (2021); investigated the effect of a campus botanical garden on student well-being. The study found that students who had regular access to the garden reported higher levels of well-being, including higher levels of happiness, life satisfaction, and emotional well-being. The study also found that students who spent time in the garden had lower levels of stress and were more likely to engage in physical activity.

It is worth noting that several factors can influence the relationship between campus green infrastructures and student well-being. For example, the type and design of green spaces, the frequency and duration of exposure, and the characteristics of the student population can all play a role. Additionally, the presence of other environmental stressors, such as noise and air pollution, can mitigate the positive effects of green spaces. Overall, the existing literature suggests that campus green infrastructures can have a positive impact on student well-being. While some studies have found mixed results, the majority of studies have found a positive relationship between green spaces and student well-being.

One potential explanation for the positive relationship between green spaces and student outcomes is that exposure to nature has been found to reduce stress and improve cognitive function (Won et. al., 2011; Fan, et. al., (2021). Spending time in green spaces may also increase physical activity, which has been linked to improved academic performance. Additionally, incorporating green spaces into educational settings may promote a sense of connection to the environment and increase environmental awareness and stewardship among students. It may also provide opportunities for hands-on learning experiences and promote creativity and imagination. In terms of incorporating green spaces into educational settings, there are a variety of strategies that could be effective, such as creating outdoor classrooms, incorporating gardens or green roofs, or

partnering with community organizations to provide access to nearby parks or natural areas. However, it is important to ensure that green spaces are accessible to all students, regardless of socioeconomic status or other factors that may impact access to green spaces outside of school.

METHODOLOGY

Case studies Area

Figure 1 shows the locations of the Osun State College of Technology (OSCOTECH, Esa-Oke) and Osun State Polytechnic, Iree (OSPOLY-Ire) in Osun State, South-Western Nigeria. Their coordinates are 07°30′N and 4°30′E. Osun State is bordered on the east by the states of Ekiti and Ondo, on the north by the state of Kwara, on the south by the state of Ogun, and on the west by the state of Oyo. In 1981, the two universities were formed as the Polytechnic, Ibadan's satellite campuses. When Otunba Isiaka Adetunji Adeleke, the State's first executive governor, signed the bill creating the Institution in October 1992, they were formally established as an institution. To fill middle-level positions, especially within the disciplines of science, engineering, environmental studies, information and communication technology, management, and financial studies, the two Polytechnic Institutions were founded.

Data Collection and Analysis

The proposed conceptual model for the impacts of campus green infrastructures towards enhancing the learning environment and improving students' academic performance in tertiary institutions in South-West, Nigeria is tested using a quantitative method research design. This design incorporates a quantitative data collection method to provide a comprehensive understanding of the relationships between green infrastructure, the learning environment, and academic performance. Therefore, the study data gathering involves the use of a survey questionnaire for undergraduate students on their perceptions of the campus green infrastructures and their academic performance and well-being.

The population for this study consists of undergraduate students from tertiary institutions in South-West, Nigeria. According to the National Universities Commission, there are over 100 tertiary institutions in the region, including universities, polytechnics, and colleges of education. The population of undergraduate students in these institutions is estimated to be over 1 million. Due to the large size of the population, the sample for this study consists of male and female (aged 18 and older) undergraduate students from the two tertiary institutions in South-West, Nigeria. These institutions are the Osun State College of Technology (OSCOTECH, Esa-oke) and Osun State Polytechnic, Ire (IRE-Polytechnic). They were selected based on their size, location, and the extent to which they have implemented green infrastructure on their campuses.

The sample size of 500 was determined using the sample size calculator tool provided by Raosoft, which is based on the population size, margin of error, and confidence level. The margin of error for this study was set at 5%, and the confidence level was set at 95%. With these parameters, the recommended sample size was 385. However, to account for potential non-response and incomplete data, the sample size was increased to 398 students recruited for the study, with 200 students and 198 students from each institution.

A stratified random sampling strategy was used to choose the participant sample. First, the selected institutions will be stratified based on their size and location. Then, a proportional sample of students will be randomly selected from each stratum. The stratified random sampling technique has several advantages. It ensures that the sample is representative of the population, which increases the external validity of the study. Also, it allows for more precise estimates by reducing the sampling error. Finally, it can reduce the cost and time required for data collection by focusing on specific strata that are of interest to the study.

The sample includes students from different disciplines and academic levels. The inclusion criteria for the sample will be undergraduate students who are currently enrolled in one of the selected institutions and who have agreed to take part in the research. Conditions for eviction includes students who are not willing or able to provide informed consent or who have a medical condition that may influence their willingness to take part in the research project. The selected sample provides a representative sample of undergraduate students from tertiary institutions in South-West, Nigeria, and will allow for a comprehensive analysis of the relationships between green infrastructure, the learning environment, and academic performance in this population. The survey eventually took place from October to December 2022, in two different selected institutions of Southwestern Nigeria; while the questionnaire was administered to the selected students using a face-to-face distribution method. These occur on different days of the week and hours of the day. The data collection took place over two weeks. Participants were given the questionnaire to complete during their classes, and to those students present at the selected green spaces on the campuses(See Fig.2&3). They were guided on the proper filling of the questionnaires, and completed surveys were returned to the research assistants.

The extent to which a measure accurately captures the notion or construct it is designed to measure is referred to as its validity.. In the case of this study, the survey was developed to assess students' perceptions. of the green infrastructure on their campuses, the learning environment, and their academic performance. The questionnaire's content validity was established by conducting a thorough review of the literature on green infrastructure, learning environment, and academic performance, and including relevant questions in the questionnaire. Additionally, a handful of students had tested the survey questionnaire. to ensure that the questions were clear, relevant, and understandable. The construct validity of the questionnaire was assessed using factor analysis to determine whether the items in the questionnaire measure the same construct. Additionally, the hypothesis testing was to confirm whether the questionnaire measures the construct of interest. The test-retest reliability of the questionnaire was assessed by administering the questionnaire to a group of students twice, with a time interval between the two administrations. The correlation coefficient was later used to determine the degree of agreement between the two administrations.

The questionnaire consisted of closed-ended questions and Likert scale items. The questionnaire was used to collect quantitative data on the student's perceptions of the green infrastructure on their campuses, the learning environment, and their academic performance. This survey has been separated into three distinct parts:

Section A: Demographic information. This section will collect information on the student's age, gender, discipline, academic level, and other relevant background information.

Section B: Perception of green infrastructure. This section will assess the students' perceptions of the green infrastructure on their campuses. It includes an evaluation of students' awareness about the Campus Green Infrastructures in both institutions; students' frequency of using Campus Green Infrastructures in the two institutions.

Section C: Learning Environment and academic performance. This section will assess the impacts of campus Green Infrastructures on their well-being and how Campus Green Infrastructures could be optimized in a bid to enhance the learning environment and improve their academic performance.

The participants were selected based on their faculties or departments, and the number of participants selected from each faculty or department was proportional to the total number of students in that faculty or department. A total of 398 valid questionnaires was gathered and analyzed statistically. The error of using this sample is estimated using a suggestion by Kothari (1990). For ethical considerations, the study was conducted following ethical principles and guidelines for research involving responses to the contents of survey questionnaires. Informed consent was obtained from all participants before data collection, and participants were informed of their right to withdraw from the study at any time without penalty. The data that was gathered was kept private and confidential, and only pooled statistics were provided in the final analysis.

Statistical Package for Social Sciences (SPSS) version 24.0 was used for the data analysis. Hence, the quantitative data collected were analyzed using descriptive statistics such as frequency counts, percentages, means, and standard deviations. Descriptive statistics were used to summarize the distribution of variables, while regression analysis was used to test the hypotheses proposed in the conceptual model. Cronbach's alpha coefficient was used to examine the questionnaire's internal consistency reliability, which indicates the degree to which the items in the questionnaire measure the same construct.

RESULTS AND FINDINGS

Demographic results

The results presented in Table 1, show the demographic characteristics of the respondents from OSCOTECH, Esa-oke, and IRE-Polytechnic. Considering population distribution, females and males are well represented by the two institutions (OSCOTECH; female-male is 47%- 53%; IRE-Polytechnic, female–male, 38.38% - 61.61%). In the total sample group of 398 students for the two institutions; the results revealed that all the age groups are well represented: OSCOTECH (49% - 18-20age groups, 45.50% - 21-25 age group;5.50%- 26-45 age group); IRE-Polytechnic (46.96%- 18-20; 46.46% - 21-25; 6.56% -26-45 age group). It should be noted that the 46-50 age group, and 51 years and above were not found in the sample size.

This is normal as only in exceptional cases this age group can be captured. Age groups 26-45 are the least represented. As for the participants' representation by all faculties levels of sample: OSCOTECH, Esa-Oke (faculty of environmental studies- 7.0%; faculty of engineering-11.5%; faculty of management and business studies - 11%; faculty of pure and applied sciences – 40%; faculty of computing and information technology –30.05%); IRE-Polytecnics (faculty of environmental studies- 12.12%; faculty of engineering-14.64%; faculty of management and business studies – 13.30%; faculty of pure and applied sciences – 37.87%; faculty of computing and information technology – 22.20%). As for the participant's marital status, for OSCOTECH, Esa-oke (87,0% are single, while 13,0% are married); IRE-Polytechnic (95.45% are single and 4.54% are married).It is important to note that the mentioned descriptive results are used to support other statistical results to draw valid conclusions.

Quantitative Results

Participants were asked to evaluate their awareness about the Campus Green Infrastructures in both institutions; by rating their responses on '*excellent*', '*good*', '*moderate*', and '*very poor*'. The outcome of the results was shown in Figures 4 and 5 respectively; which revealed that the respondents' knowledge and awareness about the Campus Green Infrastructures are moderate with the highest percentages as 105(52.5%) and 125 (63.13%) in OSCOTECH, Esa-oke and IRE Polytechnic respectively. This is an indication that the overall findings of this study are acceptable in general terms. Table 2 depicted the respondents' rating of some selected parts of the Campus Green Infrastructure in OSCOTECH, Esa-oke, and IRE-Polytechnic. The answers were evaluated over a 5-point Likert-type scale ranging from "*5-very good*" to "*1-very bad*". Therefore, the respondents' ratings of the selected parts of the two Campus Green Infrastructures revealed a moderate appraisal with almost all the areas with values ranging between 2.60 and 3.39 at a 0.005 significant level. This is considered the average score; and substantiated the necessity for improvements in the OSCOTECH, Esa-oke, and IRE-Polytechnic.

The results of the respondents' frequency of using Campus Green Infrastructures in the two campuses were captured in Figures 6 and 7 respectively. It was revealed that the respondents' frequencies of using the Campus Green Infrastructures were good for the two campuses with values of 136 (68.68%) and 128 (64%) for IRE Polytechnic and OSCOTECH, Esa-oke respectively. This contributed to the acceptance of the study's findings as well.

Table 3 and Table 4 present the results of the analysis to answer research objective one, in which the respondents were asked about the impact of Campus Green Infrastructures on students' academic performance in the two tertiary institutions in South-West, Nigeria. The Cronbach's Alpha values for the OSCOTECH, Esa-Oke, and IRE-Polytechnic are 0.915 and 0.927 respectively. Meanwhile, the mean of respondents' agreement with the acceptance of the impacts of Campus Green Infrastructures on Students' Academic Performance with the 5-point Likert scale type for all the variables falls between 4.20-5.00 for the two institutions; indicating the respondents' strong agreement. However, the relation between the impact of Green Infrastructure areas around the campus's immediate environment on students' academic performance among the male and female gender, respondents were analyzed, and the results show significant values of $P< 0.005$ with all the statements of scale for the OSCOTECH, Esa-oke, and IRE-Polytechnics. This means that there are significant relationships between genders. Meanwhile, female respondents' agreements are higher compared to males on all the scales. The results indicate that Campus Green Infrastructure areas are one of the important environmental elements capable of impacts positively on the student's academic performance.

Fig.1. Location Map of Osun State in Nigeria (Googlemap.com)

Figure 2: Pictures depicting the various Campus Green Infrastructures in OSCOTECH, ESA-OKE

Figure 3: Pictures depicting the various Campus Green Infrastructures in IRE-Polytechnic

Table 1. Demographic characteristics of the respondents

		OSCOTECH, ESA-OKE (n=200)		IRE-POLYTECHNIC (n=198)	
Independent variables		Frequency (f)	Percentage(%)	Frequency (f)	Percentage(%)
Gender	Female	**94**	47.00	**76**	38.38
	Male	**106**	53.00	**122**	61.61
Age distributions	18-20	98	49.00	93	46.96
	21-25	91	45.50	92	46.46
	26-45	11	5.50	13	6.56
	46-50	00	00.0	00.0	00.0
	51 and above	00	00.0	00.0	00.0
Faculty	FES	14	7.0	24	12,12
	FENG	23	11,5	29	14,64
	FMBS	22	11,00	26	13,13
	FPAS	80	40,00	75	37,87
	FCIT	61	30,05	44	22,22
Marital status	Single	174	87,00	189	95,45
	Married	26	13,00	09	4,54
Ethnic Background	Yoruba	145	72,50	155	78,28
	Hausa	23	11,50	16	8,08
	Igbo	32	19,80	19	19,8
	Others	13	16,00	08	9,59
Religion Background	Christian	84	42,00	79	39,89
	Muslim	108	54,00	107	54,04
	Traditionalist	08	4,00	12	6,06
Program Type	F/T ND	58	29,00	61	30,80
	F/T HND	53	26,50	53	26,76
	DPT ND	51	25,50	62	31,31
	DPT HND	33	16,50	22	16,50
	PGD	05	2,50	00	11,11
State of Origin	Oyo	32	16,00	24	12,12
	Osun	78	39,00	92	46,46
	Ogun	31	15,50	21	10,60

	Ondo	23	11,50	18	11,50
	Ekiti	16	8,00	14	9,09
	Others	20	10,00	15	7,57
	Total	200	100,0	198	100,0

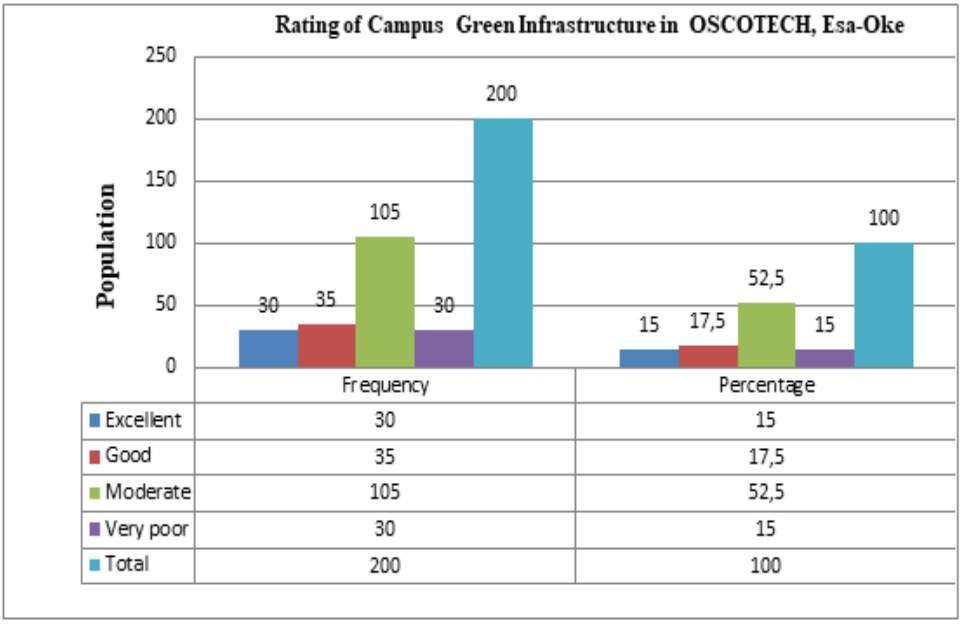


Figure 4. Respondents' rating their awareness about Campus Green Infrastructures in OSCOTECH, Esa-oke

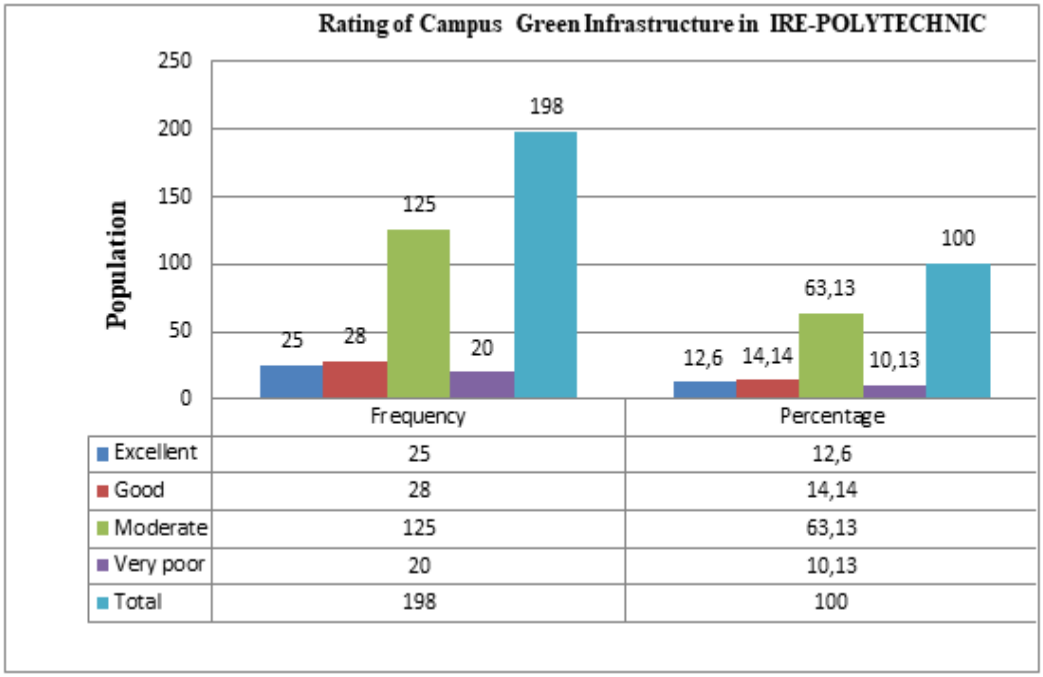
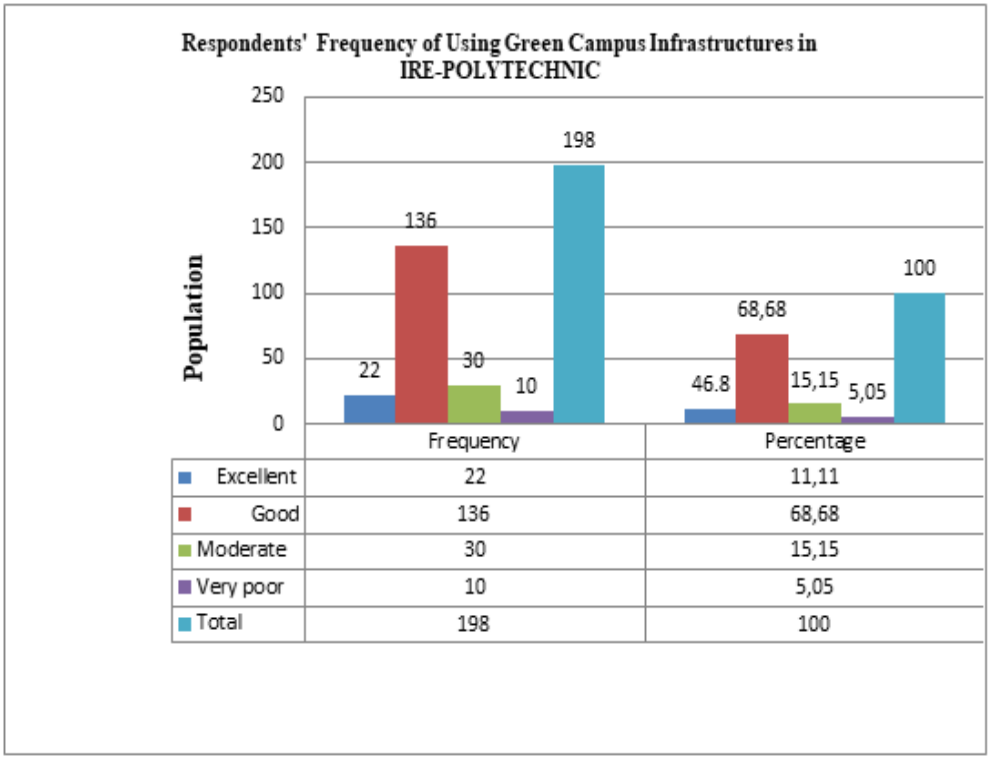
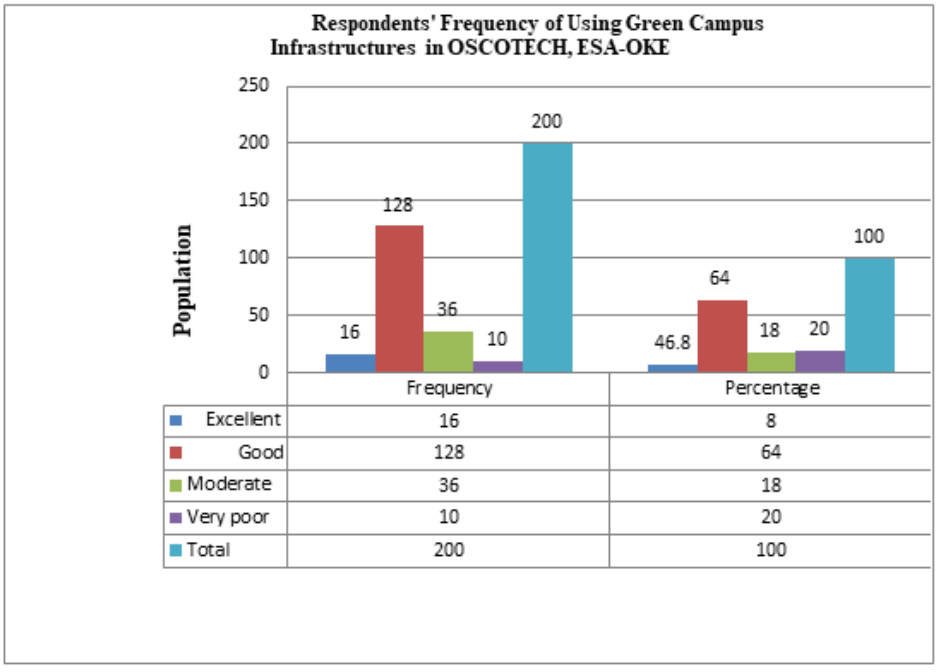


Figure 5. Respondents rating their awareness about Campus Green Infrastructures in IRE-Polytechnic



	Frequency	Percentage
Excellent	22	11,11
Good	136	68,68
Moderate	30	15,15
Very poor	10	5,05
Total	198	100

Figure 6. Respondents' frequency of using Campus Green Infrastructures in IRE-Polytechnic



	Frequency	Percentage
Excellent	16	8
Good	128	64
Moderate	36	18
Very poor	10	20
Total	200	100

Figure 7. Respondents' frequency of using Campus Green Infrastructures in OSCOTECH, Esa-oke

Table 2. Rating of the selected parts of the Campus Green Infrastructure in OSCOTECH, Esa-Oke, and IRE-Polytechnic

	OSCOTECH, ESA-OKE				IRE-POLYTECHNIC			
Strategies for a Better Planning and Conservation of Campus Green Infrastructures	**N**	**Mean**	**Std.Deviation**	**P value**	**N**	**Mean**	**Std.Deviation**	**P value**
1. Campus lawn area	200	**3.14**	1.744	**0.001**	198	**3.12**	0.834	**0.001**
2. Classroom nature – the level of naturalness in the views from all of the regular classrooms	200	**3.16**	0.842	**0.002**	198	**3.15**	0.810	**0.002**
3. Lecture / Theatre nature – the level of naturalness in the views from all of the lecture theatre.	200	**3.11**	0.847	**0.025**	198	**3.14**	1.766	**0.025**
4. Recreational facilities, such as baseball courts, tennis courts, and fields for football.	200	**3.26**	1.845	**0.021**	198	**3.31**	1.705	**0.021**
5. Parking lots - all areas of vegetation that are included inside or around the school environment along with all routes within the school's boundaries.	200	**3.28**	0.743	**0.001**	198	**3.36**	0.758	**0.001**
6.Landscaped/green areas - these include the spaces between school buildings, parking lots, classroom boundaries, outdoor courtyards, and lawn areas encircling school buildings.	200	**3.29**	0.850	**0.021**	198	**3.17**	0.758	**0.021**
7. Possibility of student access to nature. The opportunity for pupils to experience or interact with nature directly on campus	200	**3.15**	0.189	**0.001**	198	**3.18**	1.190	**0.001**

100-1.79-'Very bad'; 1.80-2.59- 'Bad'; 2.60-3.39- 'Moderate'; 3.40-4,19-'Good'; 4.20-5.00- Very good'

Table 3. The impacts of Campus Green infrastructure on Students' Academic performances among the gender (t-test)

The Impacts of Campus Green Infrastructure on Students' Academic Performances in their Institution (OSCOTECH, ESA-OKE)	**N**	Mean	Std.deviation	Gender	Mean	Std.deviation	Std.ErrorMean	Sig. p (2-tailed)
1 Campus Green infrastructure has made my interaction effective in class	200	**4.22**	0.965	Female	**4.89**	0.827	0.063	**0,001**
				Male	**4.20**	0.873	0.072	**0,002**
2. Campus Green infrastructure has helped me to be active in class	200	**4.25**	0.913	Female	**4.96**	0.823	0.063	**0,025**
				Male	**4.15**	0.860	0.071	**0,021**
3. Campus Green infrastructure has enhanced my learning	200	**4.36**	0.857	Female	**4.32**	0.603	0.037	**0,001**
				Male	**4.21**	0.912	0,043	**0,003**
4.Campus Green infrastructure has increased my frequency of participation in class	200	**4.37**	0.865	Female	**4.89**	0.751	0.067	**0,003**
				Male	**4.03**	0.949	0.066	**0,002**
5. Campus Green infrastructure has helped me concentrate in class	200	**4.28**	0.932	Female	**4.44**	0.168	0.051	**0.005**
				Male	**4.02**	0.603	0.037	**0.001**
6.. Campus Green infrastructure has helped motivate me to learn	200	**4.29**	0.932	Female	**4.30**	0.912	0.043	**0.003**
				Male	**4.21**	0.751	0.067	**0.003**
7 Campus Green infrastructure has encouraged me to attend classes	200	**4.34**	0.932	Female	**4.89**	0,949	0.066	**0.002**
				Male	**4.28**	0.816	0.051	**0.005**
8 Campus Green infrastructure has helped me think more deeply	200	**4.38**	0.932	Female	**4.99**	0.949	0.066	**0.002**
				Male	**4.88**	0.816	0.051	**0.005**

100-1.79-'*IStrongly disagree*'; 1.80-2.59- '*I do not agree*'; 2.60-3.39- '*Neutral'*; 3.40-4.19-'*I agree'*; 4.20-5.00- *I strongly agree*'

Table 4. The impacts of Campus Green infrastructure on Students' Academic performances among the gender (t-test)

The Impacts of Campus Green Infrastructure on Students' Academic Performances in their Institution (IRE-POLYTECHNIC)	N	Mean	Std.deviation	Gender	Mean	Std.deviation	Std.ErrorMean	Sig. p (2-tailed)
1.Campus Green infrastructure has made my interaction effective in class	198	**4.22**	0.965	Female	**4.89**	0.827	0.063	**0.001**
				Male	**4.25**	0.873	0.072	**0.002**
2.Campus Green infrastructure has helped me to be active in class	198	**4.95**	0.913	Female	**4.98**	0.823	0.063	**0.025**
				Male	**4.96**	0.860	0.071	**0,021**
3. Campus Green infrastructure has enhanced my learning	198	**4.36**	0.857	Female	**4.32**	0.603	0.037	**0.001**
				Male	**4.21**	0.912	0.043	**0.003**
4.Campus Green infrastructure has increased my frequency of participation in class	198	**4.37**	0.865	Female	**4.41**	0.751	0.067	**0.003**
				Male	**4.40**	0.949	0.066	**0.002**
5.Campus Green infrastructure has helped me concentrate in class	198	**4.28**	0.932	Female	**4.23**	0.816	0.051	**0.005**
				Male	**4.22**	0.603	0.037	**0.001**
6. Campus Green infrastructure has helped motivate me to learn	198	**4.27**	0.932	Female	**4.53**	0.912	0.043	**0.003**
				Male	**4.20**	0.751	0.067	**0.003**
7. Campus Green infrastructure has encouraged me to attend classes	198	**4.20**	0.932	Female	**4.89**	0.949	0.066	**0.002**
				Male	**4.28**	0.816	0.051	**0.005**
8. Campus Green infrastructure has helped me think more deeply	198	**4.25**	0.932	Female	**4.83**	0.949	0.066	**0.002**
				Male	**4.80**	0.816	0.051	**0.005**

100-1.79-'*IStrongly disagree*'; 1.80-2.59- '*I do not agree*'; 2.60-3.39- '*Neutral'*; 3.40-4,19-'*I agree'*; 4.20-5.00- *I strongly agree*'

Table 5: Hypothesis 1. Overall summary of Responses of Students of OSCOTECH, ESA-OKE, and IRE-POLYTECHNIC on the impacts of Campus Green infrastructure on Students' Academic performance

Respondents	Number	Mean	S.D	Z- value	Z-critical value	Decision
OSCOTECH, ESA-OKE Students	200	4.56	0.68	-1.15	1.96	Accepted
IRE-POLYTECHNIC Students	**198**	**4.48**	**0.72**			

Table 6: Evaluation of the benefits of campus Green Infrastructures on students' well-beings

	OSCOTECH, ESA-OKE				IRE-POLYTECHNIC			
Benefits of Campus Green Infrastructures	**N**	**Mean**	**Std.Deviation**	**P value**	**N**	**Mean**	**Std.Deviation**	**P value**
1. Exposure to the Campus Green Infrastructures gives me satisfaction every time	200	4.27	0.744	0.001	198	4.66	0.834	0.001
2. Exposure to the Campus Green Infrastructures protects me from Environmental hazards.	200	4.46	0.842	0.002	198	4.58	0.810	0.002
3. Exposure to the Campus Green Infrastructures lowers my stress levels	200	4.11	0.847	0.001	198	4.13	0.966	0.025
4. Exposure to the Campus Green Infrastructures improves my cognitive functioning	200	3,81	0.845	0.001	198	3.71	0.905	0.021
5. Exposure to the Campus Green Infrastructures improves my levels of happiness	200	3.38	0.943	0.001	198	3.26	0.965	0.001

6. Exposure to the Campus Green Infrastructures improves my emotional well-being	200	3.19	0.950	0.002	198	4.54	0.976	0.021
7. . Exposure to the Campus Green infrastructure has helped me think more deeply	200	3.19	0.950	0.001	198	4.23	0.988	0.001
8. . Exposure to the Campus Green Infrastructures has helped in building social cohesion and the relationship between me and my colleagues.	200	3.13	0.900	0.001	198	4.67	0.902	0.001

100-1.79-'*IStrongly disagree*'; 1.80-2.59- '*I do not agree*'; 2.60-3.39- '*Neutral'*; 3.40-4,19-'*I agree'*; 4.20-5.00- *I strongly agree*'

Table 7. Overall summary of Responses of Students of OSCOTECH, Esa-Oke,and IRE-Polytechnic on the benefits of Campus Green Infrastructures on their well-being

Respondent	Number	Mean	S.D	Z-value	Z-critical value	Decision
OSCOTECH, ESA-OKEStudents	200	4.19	0.824	1.37	1.96	**Accepted**
IRE-POLYTECHNIC Student	**198**	**4.48**	**1.745**			

Table 8. How Campus Green Infrastructures be Optimized To Enhance Learning Environment and Improve Students' Academic Performance

	OSCOTECH, ESA-OKE				**IRE-POLYTECHNIC**			
Strategies for a Better Planning and Conservation of Campus Green Infrastructures	**N**	**Mean**	**Std.Deviation**	***P* value**	**N**	**Mean**	**Std.Deviation**	***P value***
1. Establishment of comfortable seating elements in the areas within the campus spaces	200	4.27	1.744	0.001	198	4.66	0.834	0.001
2. Creating a better arrangement of the space for group use within the campus spaces	200	4.46	0.842	0.002	198	4.58	0.810	0.001
3. Improvement of quality and increase in the number of lighting elements within the campus spaces	200	4.11	0.847	0.001	198	4.13	1.966	0.004
4. The better choice of the ground covering materials /elements within the campus spaces	200	3.81	1.845	0.002	198	3.71	1.905	0.001
5. Regular/ routine maintenance and provisions for refuse disposal bins within the campus spaces	200	3.38	0.943	0.001	198	3.26	0.958	0.001
6. Provision of adequate facilities for the disabled within the campus spaces	200	3.19	0.950	0.001	198	4.17	0.958	0.001
7. Provision of adequate Safety and Comfort elements in the area within the campus spaces	200	4.17	0.189	0.001	198	3.18	1.190	0.001
8. Provision of shading and other protective elements against rain or sun within the campus spaces	200	3.95	1.178	0.001	198	3.86	1.719	0.001

100-1.79-'*IStrongly disagree*'; 1.80-2.59- '*I do not agree*'; 2.60-3.39- '*Neutral'*; 3.40-4,19-'*I agree'*; 4.20-5.00- *I strongly agree*'

Table 9. Overall summary of Responses of Students of OSCOTECH, ESA-OKE, and IRE-POLYTECHNIC on how Campus Green Infrastructures could be Optimized To Enhance the Learning Environment and Improve Students' Academic Performance

Respondent	Number	Mean	S.D	Z-value	Z-critical value	Decision
OSCOTECH, ESA-OKEStudents	200	4.37	0.739	1.65	1.96	**Accepted**
IRE-POLYTECHNIC Student	**198**	**4.52**	**1.832**			

These results also confirmed that Campus Green areas have been linked to students' effective interaction in class; helped students to be active in class; has enhanced students' learning experience amongst others.

In testing Hypothesis 1 of the impacts of Campus Green infrastructure on Students' Academic performance; Table 5 shows the overall summary of responses of students of OSCOTECH, Esa-oke, and IRE-Polytechnic. The calculated z-value is -1.15 and the z-critical value is 1.96; at 0.05 levels of significance. Therefore, the null hypothesis which states that there is no significant difference in the mean response of students from OSCOTECH, Esa-oke, and IRE-Polytechnic on the impacts of Campus Green infrastructure on Students' Academic performance is accepted. This shows that students of the two institutions do not differ significantly in their mean ratings on the impacts of Campus Green infrastructure on Students' Academic performance in South-west, Nigeria.

Targeting Objective 2 in terms of the evaluation of the benefits of Campus Green Infrastructures on their students' well-being; the results in Table 6present the respondents' feedback on the variables with the Cronbach's Alpha value of 0.912 and mean values ranges between 4.20-5.00 on the 5-point Likert scale for the two institutions with significant values of $p< 0.05$.This result shows that the students'' perception of the benefits of Campus Green Infrastructures on their well-being are positive in both OSCOTECH Esa-Oke and IRE Polytechnic. Students therefore strongly agreed that there are impacts of Campus Green Infrastructures on their well beings.

Testing Hypothesis H2 shows that there is no significant difference in the mean responses of students OSCOTECH, Esa-Oke, and IRE-Polytechnic on the benefits of Campus Green Infrastructures on their well-being (Table 7). The results from the table indicate that the calculated result of the z-value is 1.37 and the z-critical value is 1.96 at 0.05 levels of significance. The z-calculated value of 1.37 is less than the z-critical value of 1.96; therefore, the null hypothesis which states that there is no significant difference in the mean response of students from OSCOTECH, Esa-oke,and IRE-Polytechnic on the benefits of campus Green Infrastructures on their well-beings is accepted. This means that students from the two institutions do not differ significantly in their mean response on how the Campus green infrastructures will affect their well-being.

Objective 3 explores the respondents' perception of how Campus Green Infrastructures be optimized to enhance the learning environment and improve students' academic performance. The results in Table 8 present the respondents' feedback on the variables with the Cronbach's Alpha value of 0.918 and mean values ranging between 4.20-5.00 on the 5-point Likert scale for the two institutions. This result shows strong agreement that the campus Green Infrastructures could be optimized with all variables being positive with a significant value $p< 0.05$. This indicates that the Campus Green Infrastructures could be optimized to improve the student's academic performance in both OSCOTECH Esa-Oke and IRE Polytechnic; through the establishment of comfortable seating elements in the areas within the campus spaces; creating a better arrangement of the space for group use within the campus spaces; improvement of quality and increase in the number of lighting elements within the campus spaces amongst others. For the testing of Hypothesis 3; the data in Table 9, indicate that the calculated z-value is 1.65 and is less than the z-critical value, at 0.05 levels of significance. Hence there is no significant difference in the mean response of students from the OSCOTECH, Esa-oke, and IRE-Polytechnic on how Campus Green Infrastructures could be optimized to enhance the learning environment and improve students' academic performance.

DISCUSSION

The effects of campus green infrastructure on improving the learning environment and students' academic performance

This study aimed to investigate the impacts of campus green infrastructures on enhancing the learning environment and improving students' academic performance in tertiary institutions in South-West, Nigeria. Findings from the study showed that there is a positive relationship between the green infrastructure on campus, the learning environment, and student's academic performance. The results indicated that the presence of green infrastructure on campus significantly enhances the learning environment and contributes to improved academic performance. These findings are consistent with previous research in this area, indicating that green spaces can have a significant impact on cognitive function and academic performance. For instance, research has shown that exposure to natural environments, such as parks and green spaces, can have a positive impact on cognitive function and attention, as well as reduce stress and fatigue (Kuo & Faber Taylor, 2004;Foellmer, et. al., 2021). These effects have been attributed to a range of factors, including the restorative properties of nature, such as the ability to reduce mental fatigue, improve mood, and promote positive emotions. All these have the potential for nature to provide opportunities for physical activity and social interaction.

The findings of this research are also consistent with past studies by Kweon et al. (2017); Kweon et al. (1998); and Liu et al. (2022); that have specifically examined the relationship between Green Infrastructure on university campuses and students' academic performance. For example, a study conducted at the University of Essex found that students who had access to green spaces on campus reported higher levels of academic engagement and satisfaction (Hartig et al., 2014). Similarly, research conducted at the University of Michigan found that students who lived in residence halls with views of nature had better academic performance and lower levels of stress (Kuo & Faber Taylor, 2004).This study also found that female students have a more positive perception of the green infrastructure on campus compared to male students. However, there was no significant difference in perception of the Campus Green Infrastructure between the two institutions. These findings suggest that Green Infrastructure areas, such as parks or gardens on campus, can have a positive impact on a student's academic performance, as they provide an environment that enhances effective interaction in class, encourages students to be active in class, and improves overall learning experiences.

These findings align with previous research on the topic, which has demonstrated that exposure to natural environments can lead to improvements in cognitive function and attention, as well as reductions in stress and fatigue (Won et. al., 2011; Abu-Ghazzeh, (1999).The presence of green infrastructure on campus, positively impacts the learning environment and academic performance of students. In other words, the green infrastructure on campus provides a conducive environment for teaching and learning, reduces stress levels among students,

and enhances the overall aesthetic appeal of the campus. This finding supports the notion that incorporating green spaces into the campus environment can positively impact student learning outcomes. The descriptive statistics revealed that the mean academic performance score was higher for students who had access to green spaces compared to those who did not. This trend was observed across all the institutions sampled. Correlation analysis also revealed a strong positive correlation between green spaces and academic performance, suggesting that as the amount of green space on campus increases, so does academic performance.

The evaluation of the benefits of Campus Green Infrastructures on their students' well-beings

This study has shown that the benefits of Campus Green Infrastructures on the well-being of the students are enormous. This is consistent with the past studies of Adegun et al. (2019); in which the author equally found that students who had access to green spaces on campus reported higher levels of life satisfaction and lower levels of stress than those who did not have access to green spaces. The study also found that students who spent more time in green spaces had better cognitive functioning and higher levels of academic engagement. Similar studies by Won et. al., (2011); Foellmer, et. al., (2021) affirmed students who spent time in campus green spaces reported higher levels of well-being, including higher levels of happiness, life satisfaction, and emotional well-being.

Several studies have also concurred with this finding on the impact of green spaces on student well-being such as Seymour, (2020); Kim, et al., (2021); and Foellmer, et al., (2021). These studies are threading the current growing interest in greening organizations and educational institutions. In addition, a study by Barton & Rogerson, (2017) buttressed the impact of campus green spaces on students' mental health. The study found that students who had access to green spaces reported lower levels of anxiety and depression than those who did not have access to green spaces. The study also found that students who spent more time in green spaces had higher levels of resilience and coping skills. Another study that agreed with this study's findings is Munonye, (2020); who revealed as well that the impact of exposure to green roofs on student well-being. The study found that students who had classrooms with green roofs reported higher levels of well-being, including higher levels of happiness, life satisfaction, and emotional well-being (Seymour, 2020; Foellmer, et. al., 2021). The study also found that students who spent time in classrooms with green roofs had lower levels of stress and were more likely to engage in physical activity.

Strategies on How Campus Green Infrastructures be Optimized To Enhance Learning Environment and Improve Students' Academic Performance

This study suggests that the campus Green Infrastructures could be optimized to improve student's learning environment and improve academic performances. The findings of this study suggest that optimizing the campus's Green Infrastructures includes incorporating comfortable seating elements, improving the arrangement of space for group use, and enhancing lighting and other features. Through these, universities can create a more conducive environment for learning, promoting positive emotions, reducing stress and anxiety, and improving cognitive function (Won et. al., 2011;Abu-Ghazzeh, (1999). Specifically, the findings showed strong agreement among the respondents that optimizing Green Infrastructures with various positive variables, such as comfortable seating elements, better arrangement of space for group use, and improved lighting, can lead to significant improvements in academic performance. The idea of optimizing green spaces on campus in this study has been equally substantiated as previous studies in that creating a more conducive environment for learning can have a positive impact on student's academic performance (Kweon et al., 1998; Hartig et al., 2014). In particular, incorporating nature and green spaces into the built environment of schools and universities can promote positive emotions, reduce stress and anxiety, and improve cognitive function (Kuo & Faber, 2004).

The specific suggestions for optimizing the campus Green Infrastructures mentioned in this study are consistent with previous research by Hartig et al., (2014) and Kweon et al., (1998). The authors agreed to the terms that providing comfortable seating elements within green spaces has been shown to encourage students to spend more time outdoors, which can lead to increased physical activity and improved mental well-being. Similarly, creating better arrangements for group use within green spaces can promote social interactions and collaboration, which can improve learning outcomes. Improving lighting within green spaces is another important factor that can positively impact students' well-being. Adequate lighting can improve visibility and reduce eye strain, leading to improved concentration and focus. In addition, lighting can also affect mood and emotional well-being, with natural daylight having a particularly positive effect (Moyano, et. al., 2020). Results from the studies on the adolescent playing ground in the Southwest, Nigeria by Agboola et.al.,(2017); had the findings that through participation in excellent and well-equipped playgrounds, campus students and other teens will experience beneficial attitudinal improvements as well as a reduction in social vices and delinquent behavior. Adolescent engaging in activities on the playground also plays a significant effect in boosting their sense of social wellness and connectedness.

CONCLUSION AND RECOMMENDATION

This research has documented the level of the campus' green planning, management, and sustainable development intending to enhance the learning environment and improve students' academic performance in Nigeria tertiary institutions in the South-West, and beyond. Overall, the findings from this study support the hypothesis that the green infrastructure on campus has a positive impact on the learning environment and academic performance of students. The study also suggests that the green infrastructure on campus could be used as a tool for promoting sustainability and environmental awareness among students. Conclusively, this research has provided valuable insights into the level of campus green planning, management, and sustainable development in South-west, Nigeria, intending to enhance the learning environment and improve students' academic performance. The findings demonstrate that there is a considerable need for investment in green infrastructure on campuses to improve the quality of life for students and staff, promote sustainable development, and contribute to a healthier environment.

The study reveals that the presence of green infrastructure on campus positively influences students' academic performance and well-being. In other words, the importance of incorporating green infrastructure into the planning and management of tertiary

institutions in South-west Nigeria could not be over-emphasized. This can be achieved by adopting sustainable development principles, promoting green practices, and investing in green infrastructure. Such efforts can also create job opportunities and promote economic development. For instance, students who have access to green spaces tend to have lower levels of stress, higher levels of satisfaction, and better academic performance. Additionally, green infrastructure can enhance the aesthetic quality of the campus, attract potential students, and create a conducive learning environment. Other conclusions include the under-listed:

(i) This study stands to promote integrated management of the campus environment in a bid to enhance all aspects of the institutional landscaped environment and students' academic performance. This suggests that the study promotes integrated management of the campus environment to enhance all aspects of the institutional landscaped environment and students' academic performance. In other words, the study advocates for a holistic approach to the management of campus green infrastructure, considering not just the aesthetic quality of the environment but also its impact on student's academic performance and well-being.

(ii) A well-designed campus landscape can also serve as a source of inspiration for students, encouraging them to explore, learn, and engage with their environment. Overall, the integration of green infrastructure management into campus planning and development can have significant benefits for student's academic performance and well-being. By creating a more conducive learning environment, tertiary institutions can improve student retention rates, attract top talent, and contribute to the development of skilled graduates. Additionally, by promoting sustainable development practices, institutions can help to create a more sustainable future and contribute to the well-being of the wider community.

(iii) This study's output will be relevant to policymakers in adopting fundamental campus planning and design strategies for ecosystem development and sustainability in Nigeria. The statement suggests that the output of the study will be relevant to policymakers in adopting fundamental campus planning and design strategies for ecosystem development and sustainability in Nigeria. In other words, the study's findings and recommendations can inform policy decisions that promote sustainable development and green infrastructure management in tertiary institutions across Nigeria. Additionally, by creating a more conducive learning environment, green infrastructure can help to improve the quality of education and contribute to the development of skilled graduates. A more sustainable and vibrant learning environment, promote economic development and contribute to the well-being of the wider community.

(iv) This study advocates for a pedagogical approach that prioritizes the development of student's personal and social skills alongside academic knowledge. Participation, research, and transferable skills are important components of a holistic education that goes beyond the traditional classroom setting. Participation in extracurricular activities such as student organizations, community service, and campus events can help to develop students' leadership, communication, and interpersonal skills. It can also provide opportunities for networking, building social capital, and developing a sense of belonging.

(v) Some of the following Nigerian agencies will immensely benefit from the study's findings (a) Federal and State Ministry of Environment in Nigeria (b) Climate Change Network Nigeria (CCNN); (c) National Board for Technical Education (NBTE).

However, the research also reveals several challenges associated with the implementation and management of green infrastructure on campuses. These include inadequate funding, lack of expertise, poor maintenance, and inadequate policy framework. To address these challenges, there is a need for increased investment in green infrastructure and the development of policies that promote sustainable development. By adopting sustainable development principles, promoting green practices, and investing in green infrastructure, tertiary institutions can contribute to a healthier environment, promote sustainable development, and create a conducive learning environment for students.

Based on the conclusion of this research activity on the impacts of campus green infrastructures towards enhancing the learning environment and improving students' academic performance in tertiary institutions in South-West, Nigeria, there are several suggestions for further research that can be considered. These suggestions are as follows:

(i) To determine the long-term impacts of campus green infrastructure on students' academic performance and well-being, there is a need for longitudinal studies. Such studies can track the progress of students over a more extended period, analyzing how green infrastructure affects their academic performance and overall well-being over time.

(ii) The researchers could also investigate the potential impact of green spaces on different age groups, as well as on students from diverse backgrounds.

(iii) Comparative studies: Comparative studies can be conducted to compare the impacts of campus green infrastructure on students' academic performance in Nigeria with other countries. This research can provide valuable insights into how campus green infrastructure affects students' academic performance and well-being in different contexts.

(iv) The cultural and social factors that may influence the relationship between campus green infrastructure and academic performance need to be examined. For instance, certain cultural and social norms may impact how students perceive and interact with green spaces.

CONFLICT OF INTEREST

The authors hereby declare that we are aware of the potential conflict of interest arising from our involvement in both the planning and research implementation of the study.

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