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University Campus Design and Post Covid-19 Adaptations; Limited Study of 10 Campus Improvement Plans

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***Abstract*—** *University campus design and planning has been an active research topic lately, Kenney et al. (2005) advocated a comprehensive university campus plan that "prioritizes the plan, establishes a language of landscape elements, embraces environmental considerations, reduces of vehicular traffic, integrates technology, and enhances the beauty and meaning of special places on campus". University campus planning gained more interest post COVID-19 as a tool to impede the spread of disease and improve the quality of students' lives as outdoor activities proved to lead to a healthier life. University campuses are controlled access communities that fit the vision of China Manual 2020, to stop the spread of possible pandemics when designed with no through-traffic penetrations. For pandemic resistant university campuses, they need to be considered 15-minute communities that provide all the necessary amenities and services for their users without having to wander into the surrounding communities (Knight, Gehl, 2021). The purpose of this study is to understand University Campus adaptations after COVID-19 to encourage students to use their campus outdoors and create design and planning guidelines. A study sample of ten university campuses was selected: three across the globe and Seven national universities. The research starts with literature review of the topic and a critical analysis of campus improvement plans for the selected universities, especially those adopted after the pandemic. Comparative analysis of the university campuses covered their published improvement plans and the maps showing the proposed physical changes, ending with a summary of the different proposed university campus development guidelines.*

I. INTRODUCTION

University campus design has a special place in urban design as it combines dealing with the physical context (microclimate, topography, mobility, surrounding context, etc.) while being influenced by the university education management system, the university spatial organization, and students' behavior. A university with a central education management that has colleges sharing central laboratories, libraries, and services has a site plan with less buildings, a higher density, more opportunities for social interaction, and a stronger overall campus character (Sonja, Mina , & Glyn, 2022). While separate services and laboratories for the different colleges give identity to each college and more opportunities for social interaction within the same college Duplication of laboratories and facilities is a possible disadvantage of the college-specific university organization system. Central campus organizations are deemed to bring students from different programs together more than college-specific universities that separate students of different programs (Sonja, Mina, & Glyn, 2022). A college specific campus will show more student mobility between the college facilities and buildings while a central campus will show more distributed student mobility among the whole campus buildings and facilities. Universities might have a unified campus, different campuses within proximity, or even different campuses and facilities dispersed over a large geographic area. University campus plans within an urban area might be widely dispersed according to the availability of land and the historic development of the area, while a suburban or rural location might allow a large, clustered university campus. Example of a central campus is the University of Findlay Old Main campus, and an example of a college specific campus is Alabama A&M University, which is also an example of a unified education campus with satellite locations for the agricultural research center and facilities. University of Pennsylvania in Philadelphia is an urban, high-density campus while University of Michigan at An-Arbor campus is a low-density suburban setting.

Many attempts were previously made to establish the factors affecting university campus design; Kenney et al. (2005) emphasized more campus design/planning aspects; a comprehensive campus plan that prioritizes the plan, establish a language of landscape elements, embrace environmental considerations, reduce the impact of vehicles, integrate technology, and enhance the beauty and meaning of special places on campus. Matloob *et al.*, (2014) emphasized a higher campus planning level; accessibility, safety and social engagement. Ozgur & Sinem (2017) focused on campus design to be accessible, holistic, sustainable, and developable because university campuses are important urban spaces within their cities that contribute positively to their vitality.

Agrawal & Yadav (2021) proposed post-covid campus design guidelines for a more resilient university campus open space system, circulation, landscape regulations, site lighting, furnishings, signage plan, building placement, orientation, building massing, materials, and color palette. In addition, universities have always placed a priority on the safety, security, and social wellbeing of their students in their campus design (Agrawal & Yadav, 2021). University campus planning had been the focus of many studies before COVID-19 to improve the quality of students' lives and their campus experience, but that even became more urgent after the pandemic when outdoor city functioning proved to be a healthier life option.

Online education during Covid-19 pandemic denied those entering the university education system for the first time the social communication opportunities of a normal university campus life. Post-pandemic university campus plans focused on providing controlled outdoor activities and less density in the classroom to safeguard against future health scares. University campus plans became a special case of urban design because of their high density of users and need to integrate the outdoor public space to mitigate high density impact on the spread of disease.

The purpose of this study is to understand University Campus adaptations after COVID-19 to encourage students to use their campus outdoors and create design and planning guidelines for walkable and healthier campuses. Ten university campuses were selected across the globe including Oxford University, UK, Chinese University of Hong Kong, Ryerson University, Canada, Ain Shams University and Cairo University, Egypt, Ahmed Bello University and Ibadan University, Nigeria, and University for Development Studies, Ghana. Universities selected in the U.S. were University of Alabama, Florida State University, and University of Iowa. However, due to lack of enough data, five universities from the African region were replaced with four additional US universities: Clemson University, North Carolina State University, Radford University, and Princeton University. The ten selected university campuses for this research belong to different contexts, climate zones, management system, campus organization, and demographics which will make the proposed design guidelines considerate to these contextual variations.

II. Literature review; Post-Covid19 University Campuses

This research component reviews published articles, journals, reports, and books covering different aspects of university campus design; students' interaction with key elements of the campus design, and levels of campus planning that impact on its outdoor activities.

University campus functions are active components of their cities; thus, the creation of healthier and more sustainable campuses will impact on their city surroundings. In case of another pandemic, university campuses might be clearly defined as urban components that can protect their population from mixing with other population groups making them less vulnerable to the spread of disease. (China Manual 2020) University campuses fit that vision of a controlled access healthy community that can stop the spread of possible pandemics when designed for that purpose with no through-traffic penetrations. "Self-contained" university campuses are to be planned to promote healthy living for their dense population and provide them with the necessary services and amenities (China manual 2020, Knight-Gehl, 2021). Consequently, university campuses need to be treated as embodiments of the 15-minute communities that are most resilient to pandemics internally while being protected from external pandemic outbursts.

Public spaces are at the heart of university campuses, they can adapt to solo and social activities to protect the users from having to wander around into surrounding communities' public spaces. Knight, Gehl 2021, showed that some public spaces in the studied projects had more foot traffic during the pandemic mainly because people were not allowed to wander outside, and that the newly created activities were attractive to the local population. The closure of most indoor recreational buildings that offer us social solace (museums, restaurants, concert halls, art galleries, clubs, etc.) have opened our eyes to the great local outdoors. CityLab from +Plus, F+P, asked people around the world to map their lives in quarantine. A common theme in hand-drawn maps from cities around the world is parks and green streets. (+Plus, F+P, Tactical urbanism 13 May 2020).

Adding this focus on local parks and leafy streets to the previously discussed characteristics of university campuses as controlled-access urban districts, that have more public spaces with activities make campus design guidelines more resilient to pandemics. Overall campus design concepts discussed by Keeny, 2005, Ozgur & Sinen 2017, and Argawal 2021, creates overall university campus planning guidelines that focus on green landscape with outdoor activities, aesthetics, controlled vehicular traffic and distributed parking for safety, better accessibility with pedestrianization and biking, and integrated technology and energy. Those main campus planning directions will be discussed next.

University Campus open space and greenery

The COVID-19 pandemic has disrupted people's travel behaviors and participation at social gatherings (Sehra et al., 2020; & Ghanim et al., 2022). Joanne et al., 2023, in their research concluded that poor social connections are associated with higher levels of depression and loneliness among first year students and recommends that, greater efforts need to be made to consider relational aspects of space and wellbeing in the design and stewardship of student spaces. To improve student health, campuses should offer outdoor amenities that encourage physical activity, create a flexible and diverse array of green buildings with open spaces and outdoor areas, accommodating a broad range of users and activities (Agrawal & Yadav, 2021; Stephen, *et al.*, 2014) including students with disabilities (Ilkay, 2021). Easy access open spaces are more likely to be used for social interaction, while less accessible spaces are for personal activities (Agrawal & Yadav, 2021). The design of the university campus should address occupational and mental health needs to promote recovery and rehabilitation.

Post-Covid19 research after 2020 was multi-disciplinary as every discipline had its own perspective and concerns about the post-pandemic future. Human development and work perspectives' focus was on the efficiency of the worker, overwork, relationship with supervisors, and mental wellness as the Pandemic caused involuntary remote work experiences (Anne et al. 2019; Johnson, Andrey, and Shaw 2007), that cannot be completely explained by the pre-pandemic research on telework and its social and economic advantages and disadvantages (Illegems, Verbeke, and S'Jegers 2001). Using the same token; post-pandemic university campus design for hybrid and online education required different guidelines than those offered for campuses with online education that was promoted in prior years. Post pandemic hybrid and online education needed to consider for the first time the social and

mental wellbeing of the students. Online and hybrid education intensity in pandemic and post-pandemic time caused overwork for the faculty and staff, burn-out for students, and mental wellness issues for all.

The pandemic-induced research suggests that remote work encouraged work intensification (Akuoko, Aggrey, and Dokbila Mengba 2021; Craig and Churchill 2021; Parlak, Celebi Cakiroglu, and Oksuz Gul 2021; Bin et al. 2021, in Melika Shirmohammadi, et al, 2022). When households' activities were predominantly confined to the place of residence, space limitations became a challenge for many remote workers (Hertz, Mattes, and Shook 2021; Karl, Peluchette, and Aghakhani 2021; Risi, Pronzato, and Di Fraia 2021, in Melika Shirmohammadi, et al, 2022). As a result, some innovative workplaces started to spring up in balconies, front lawns, or even public parks. The same was happening to students and faculty at universities during the pandemic; teaching locations started to be inventive in outdoor and home locations. Faculty and students' residences needed upgrades to allow for education interaction spaces to accommodate lectures, class discussions, student group work, project presentations, and other two-way communication needs. University campuses and education spaces needed to be treated for their social and mental-wellbeing impacts, they were treated as workplaces. A new hybrid approach to living, work and leisure space developed during the pandemic is worth considering in the design of university campuses. +plus, F+P. May 2021 survey showed that workplaces became places that fulfil larger societal and wellbeing functions by integrating life and work, a place of deeper connection, identity, sociality and experience. Consequently, university campuses are special "Live-Work-Entertain" communities which benefited from post-pandemic research on the post-pandemic hybrid work environment for "work at home and entertain locally".

Research on public health/ epidemiology, relevant to 1995 Chicago heat wave, concluded that those at greatest risk of dying from the heat were people with medical illnesses who were socially isolated. J C Semenza, et al, 1996. Similarly, social isolation of students, as that of Covid 19-pandemic, was a probable cause of more physical and mental health hazards, especially for freshmen who are still adjusting and recreating their own social support network on campus.

ILO, WRC, 2021, recommended the introduction of a 'right to disconnect' workplace policy to mitigate the risk of overwork and blurring of work and personal life that happens because of online and at-home work. From an urban design /planning perspective that meant disconnect from work and at-home-work environments, giving more focus to biophilia, connection to nature and restorative landscape. The first Author's experience in pandemic teaching is that students were engaging with lectures while in a balcony, a green area, or even in a parked car viewing nature during online lectures and class work. In fall 2022, The first Author ran a quick survey for students in three different graduate and undergraduate courses at Alabama A&M University, about their preference to come back to the university or stay online, it was an 80+% majority preferred to come back to class because of the high stress online education. However, some aspects of online teaching benefited post-pandemic campus planning by expecting some of all the offered courses to be partially or fully online so that students and faculty do not need to be on campus every day. Post-pandemic student-faculty interactions can still benefit from online meeting platforms, course assignments and grading can still take place online. Post-pandemic university campus plans are expected to consider some online education activities, including teaching, and focusing campus planning on activities that cannot be performed online such as laboratories, outdoor spaces, lecture halls, and interaction venues.

Knight Foundation and Gehl comparative study, 2021, concluded that public spaces were central to their communities' activities during the pandemic, and that community participation is key to an increased use and sense of attachment to the spaces. The study focuses on the organizational and management components of public spaces is relevant to university campus design and calls for university administration to engage the users in their campus design, students, faculty and staff (Knight, Gehl 2021). The Knight/Gehl study found that "public spaces with a strong foundation of resident engagement helped communities address equitable access and weather the pandemic together". That finding is pivotal to university campus design where students and faculty engage in campus design. Open spaces located between university buildings can integrate and organize different places, provide an aesthetic sense, offer a relaxing atmosphere, and contribute to creating sustainable environments on campus. They can create a healthy community that provides comfort and sustenance for users (Stephen *et al.,* 2014).

University campus outdoor spaces afford students the opportunity to meet, learn, interact, and foster a sense of belonging (Stephen *et al.,* 2014; İlkay, 2021; Agrawal & Yadav, 2021). that was affirmative to previous studies that asserted a positive effect of nature on our health, therefore, open spaces with natural elements such as green plants, flowers, and water features can promote healing and reduce stress levels. To ensure that campus open spaces are functional, they must be clear and comprehensible (Stephen *et al.,* 2014) and encourage people to engage in a wide range of exercise (Agrawal & Yadav, 2021). Exposure to sunlight, fragrant flowers, and soothing sounds of birds and water can help people cope with stress and feel rejuvenated (Stephen et al., 2014). However, Victoria (2019) noted that many University Campus Master Plans do not recognize the value in planning for restorative landscapes on campus. Within this research sample, North Carolina State University had a clear objective for creating student spaces to encourage students to have social interaction. Ryerson University also has a space plan for its campus, and Clemson University has a green and open space plan.

(Graph 1; Pedestrian and open space plans compiled by the authors)

Better mobility with pedestrianization and biking

In their bibliographic review, Eugene & Wayne (2021) emphasized the importance of making pedestrian traffic the primary mobility mode between buildings as an essential component of design element of campus in the campus design guideline.

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Walkway designs significantly affect people's comfort; so factors such as width, separation from street, paving quality, plants, and weather protection contribute to pedestrian comfort (Matloob *at al.,* 2014). Pedestrian comfort and safety are given priority in campus planning by placing a pedestrian network between education and social buildings (Ozgur & Sinem, 2017). In that study, most students choose to walk or use a wheelchair to access campus spaces and buildings instead of the shuttle. Walking allows for a more complete perception of the environment through different senses, which is important for safe and independent access to any desired destination İlkay (2021). When it comes to designing university campuses, it is essential to ensure that there's a clear continuity in orientation cues as it enables them to navigate campus spaces with ease İlkay (2021). Students who reside closer to campus have greater access to campus resources and are more likely to complete their degrees with better health outcomes (Nelson et al., 2016).

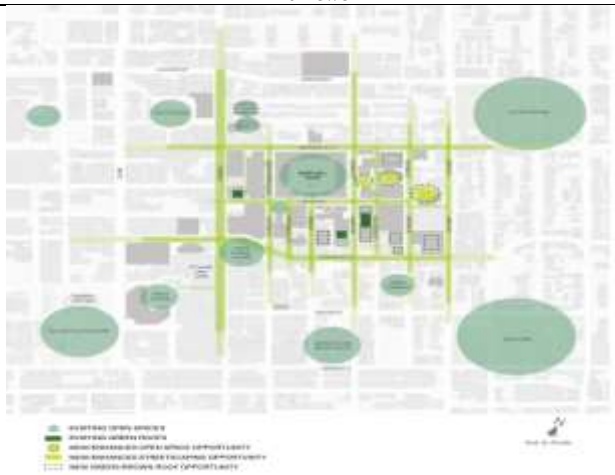
To improve the walking experience within a university campus, it is recommended to provide shade using tree canopies or shades. These should be arranged in a way that creates a continuous and smooth covered top for the walkway (Agrawal & Yadav, 2021). Setting university of San Diego California as an example, Agrawal & Yadav, (2021) argue that the street should have unique paving patterns, public speaking platforms, socializing spaces and that the groves in the vicinity help in directing pedestrians, while the resting areas add to the beauty of the scenery. İlkay (2021) suggested that, to encourage walking in universities, it is crucial to offer the quickest and most accessible pathways from shuttle stops and parking lots to classroom buildings. Pedestrian shortcuts between commonly used outdoor spaces and buildings can shorten travel times and efforts while increasing occasions for social interaction. Several articles point out that walkability of campus and its landscape are positive markers for the quality of life for students, impacts learning and cause overall students' satisfaction (Agrawal & Yadav, 2021).

Encouraged by the emergency powers granted by local and central governments, cities around the world were widening cycle lanes and pavements post Covid-19 pandemic: Paris has added 650 km of cycle lanes, Lima has added 300 km, and New York has added sixty-four km since the lockdown which continued between March 2019 and May 2020. In our research sample; the pedestrianization and biking objective was clearly spelled out in campus development plans for eight universities out of ten sample size.

Controlled vehicular traffic and parking,

According to their research, Agrawal & Yadav, (2021) presented campus circulation, parking and transportation as central aspects of sustainability in how students relate to campus design. They further stated that the quality of the physical environment, as well as a strong commitment to sustainability, has a significant impact on students' satisfaction. However, Ozgur & Sinem (2017) argued that the layout and design of a campus can significantly impact its sustainability, and providing open spaces and recreational areas promotes a sustainable walkable environment. Bus stops at some vantage places on campus allow students with disabilities to get on/out of the campus shuttles, facilitating their sustainable movement (İlkay, 2021).

1-1; North Carolina State University Pedestrian and Open Space Framework



1-2; Ryerson University Open Space Plan

1-3; Clemson University Open/Green Space/Land scape plan

Graph 1; Pedestrian and open space plans in sample universities

2-1; The University of Alabama - Tuscaloosa's Campus Pedestrian Mobility Plan

2-2; The University of Alabama Tuscaloosa's Campus biking plan

2-3; North Carolina State University Pedestrian Mobility Plan

2-4; Ryerson Campus Bicycle mobility Plan

2-5; Ryerson University Walkability Plan

2-6; Clemson University walkability plan

2-7: Chinese University of Hong Kong Walkability plan

2-8; Princeton University Walkability Plan

Graph 2; Sample universities' walkability and biking plans

Many universities restricted vehicular movement (Clemson University, 2017; University of Alabama 2017; Radford University, 2020; Florida State University, 2020; North Carolina State University, 2023) to reduce the effects of vehicular traffic and parking. According to research, courtyards and window views can provide user stimulation, which helps improve indoor users' restoration. Visual accessibility to the outdoors and a close connection to open spaces encourage the users to use the outdoors more frequently, especially if the outdoor spaces are connected within a network. Pedestrian and vehicular mobility can be integrated into a system, creating order, and promoting quick circulation (Agrawal & Yadav, 2021).

From epidemiology point of view, the scarcity of large and small open spaces in the urban fabric with unequal distribution, was discovered to be a factor in making the spread of Covid-19 even worse. China report 2020 showed the need for the distribution of medical supplies across the city and the use of small and large open spaces as mobility hubs for infected patients:

"During an epidemic, open spaces in a city can be set up as temporary storage areas for supplies and for the temporary removal of patients."

That meant insufficient size and distribution of urban open space became a factor in less city resilience and its potential for "coping with risks" (China Manual 2020). Public open spaces became important factors for the provision of temporary quarantine spots and facilities in dense urban environments (Pisano 2020).

Seven universities of the research survey sample had some element of controlled vehicular traffic; Oxford University, University of Alabama, Florida State University, North Carolina State University, Chinese University of Hong Kong (CUHK), Ryerson University, Clemson University, while Radford University focused on distributing small parking areas across the campus.

III. The Discussion

All universities selected for the sample are implementing various strategies to promote physical activity and outdoor engagement among students, they all promoted active mobility and outdoor design elements in the Campus Master Plans (CMP). Analysis of the campus master plans created patterns and similarities for campus developments, and a summary conclusion was drawn based on thematic discussions of various universities' campus design elements.

The following table (table 1 - created by the authors) summarizes the ten university campus improvement strategies and policies taken:

Table 1

University	Strategies	Policies	Year of Campus Master plan
Oxford University (Science Area)	Improve landscape and safety	1. enhance pedestrians and cyclists' paths 2. manage vehicular movement on campus for safety	Mater plan areas (retrieved 9/22/2023)
University of Alabama (Tuscaloosa)	Provide safe & aesthetically-pleasing campus to support walking & bicycling	1. Create sidewalks & bike lanes along streets 2. Create pedestrian and multi-use paths 3. Enhance corridors designed and designated for pedestrian and bicycle use. 4. provide bicycle storage racks, repair facilities 5. Conduct safety education 6.Enhance streetscape and intersection changes 7. Create walkway extensions 8. Administer a bike rental program	Campus Master Plan (2017)
	Reduce pedestrian vehicular conflicts	1.Design and location of pedestrian crossings 2. Active management of internal traffic. 3. Place parking facilities at campus perimeters. 4. Restrict vehicular access to campus core 5. Convert inner roads to pedestrian and bicycle modes.	
Florida State University, Tallahassee campus	Improve pedestrian accessibility to campus core	1. Relocate vehicle parking lots at campus periphery 2. Enhance pedestrian and roadways 3. Provide additional width and safety designs for pedestrian and bicycle path 4. Maintain and enhance pedestrian-oriented campus interior. 3. restrict vehicular access at the campus PPZ	University Campus Master plan (2020)
	Reduce dependence on single-occupant automobiles	1. Increase campus bus services to new areas 2. Continue to use the local roads around the campus interior.	
	Optimize and conserve energy	1. Interconnect steam production facilities to reduce energy consumption	
University of Iowa	Establish and renovate new and existing ultra-modern health and wellness facilities.	1. Establish gym & fitness center 2. Modernize basketball center 3. Renovate research facility, hospital tower and ambulatory care center.	Campus Bikeway Master Plan (2019) Campus master plan 2020
	Increase and modernize health care services to students and residents.	1. Increase capacity for Medicaid beneficiaries 2. Innovate more care model through telemedicine, to achieve greater efficiency 3. Partners in all parts of the state to help keep more complex care local	
North Carolina State University	Promote safe bicycling and walking on campus	1. Convert internal streets into multi-modal, pedestrian-first paths 2. expand bicycle and walking paths	Transportation master plan (2017)

		3. Creates pedestrian crossing on perimeter roads.	Campus master plan (2023)
	Provide incentives to students and employees who opt for walking and biking.	1. Provide free bicycle registration 2. Provide bicycle racks on buses 3. Guaranteed Ride Home for vanpool participants 4. Provide accessible bicycle parking lots	
	Discourage the use of private vehicle	1. Pay-As-You-Go Parking policy 2. Institute a Park Once approach, 3. Proposed No First-Year Student Parking. 4. Ensure Campus transit is moving around campus core all time.	
	Open spaces that promote interaction	1. Create new student centered spaces that are welcoming and inclusive 2. Create a more porous and inviting campus edge that strengthens links to the surrounding community 3. Create more opens spaces within campus residents and halls	
Princeton University	Reduce Greenhouse Gas Emissions	1. Increase the use of green electricity 2. Increase use of solar power and biofuels 3. reduce dependence on carbon-generated energy 4. Reduce commuter parking lots to discourage single occupancy vehicles 5. Increase access to on campus transit services	Princeton university Campus Plan (2017)
	Ensure a sustainable transportation	1. create and encourage more walking and cycling ways to minimize vehicular-pedestrian-bicycling conflicts 2. Create a comprehensive campus-wide cycling network. 3. create bike-share stations, showers and lockers, changing areas 4. provide a secured bicycle locker 5. Create walking/cycling paths to the transit stations	
Chinese University of Hong Kong	Encourage smart mobility for environmental sustainability	1. Park and ride system 2. encourage more shuttles use 3. more bicycling & walking routes 4. Ecstatic walking environment 5. Create more campus walking trails 6. Exercise and fitness facilities and spaces along walking trails	University of Hong Kong Strategic plan (2021) Active Walking trails Brochures 1,2,3,&4 (retrieved 10/30/2023)
Ryerson University	Improve active transportation participation	1. Increase the amount of bike parking on campus 2. Increase sidewalks and reduce vehicle roads in campus core 3. Provide internal mapping within the campus core to guides pedestrian movement 4. Deliberately place bike parking near campus gateways and common destinations for cyclists. 5. Relocate or remove bicycle storage that act as an impediment to pedestrian movement and safety. 6. Adopt vehicle restrictions and create new pedestrian-only areas	University campus master plan 2020
Clemson University	Ensures a safe Walk-able Campus	1. Establish PPZ on campus 2. Close streets within the PPZ to general vehicular traffic 3. Relocating parking to the campus periphery 4. Diverting traffic of inner roads to perimeter roads 5. Expanding the bicycle network on campus and adjoin to city neighborhood 6. Locating transit hubs to provide convenient access to the PPZ 7. Eliminate vertical impediments to stairs and steep slopes on campus	University Long-range Framework plan (2017)
Radford University	Decongest and increase pedestrian accessibility	1. Relocate parking lots to campus periphery. 2. plant more tree along open spaces to enhance pedestrian accessibility 3.create bike racks throughout campus 4. plan for bike-sharing program 5.small parking areas to be provided within campus core for emergency parking 6. Grade storm impact on pedestrian routes. 7. Create interactive campus mobile app to allow easy real-time campus navigation. Remove bus stops from dense and congested areas	University master plan (2020)

As summarized in the table, university campus improvements coincided with the previously discussed research for post-Covid-19 impacts on cities were: walkability, open space systems, biking, and vehicular traffic restrictions.

University campus design strategies and policies showed that walkability and biking coincided in all cases with better mobility, as they both serve each other and impact each other directly, and were always supported by open space and green landscape design. Seven out of the ten universities' sample: North Carolina State University, Florida State University, Clemson University, Ryerson University, Radford University, and University of Alabama in Tuscaloosa, have their campus design influenced by walkability and biking for better social interaction. Walkability and biking required policies to provide safe, accessible, and aesthetically pleasing campuses to encourage the interaction of students and faculty. This could be

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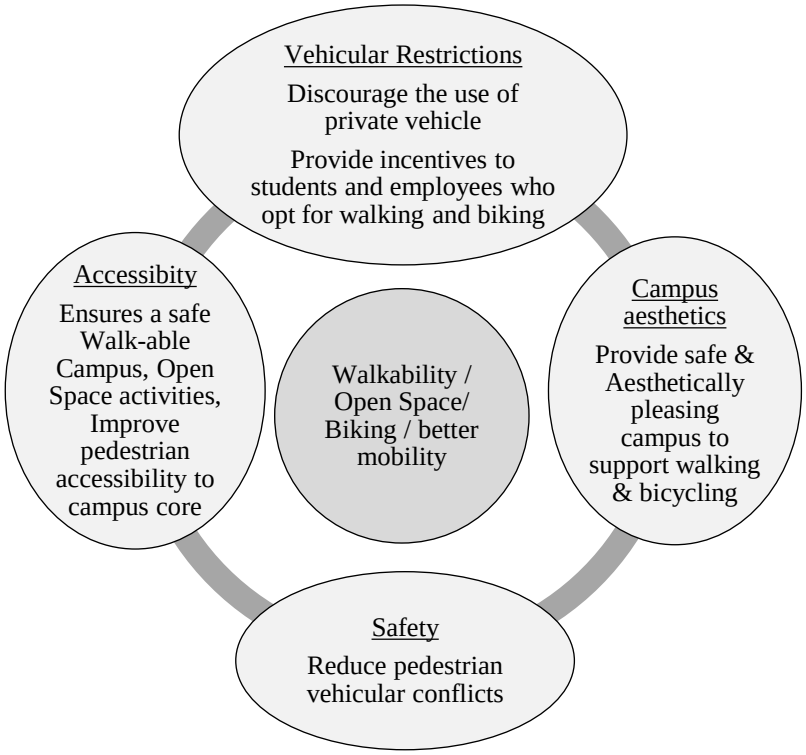
related to COVID-19 pandemic that has disrupted people's social interactions (Yang *et al.,* 2023). Joanne *et al.,* 2023 in their paper concluded that poor social connection was associated with higher levels of depression and loneliness among students and advised that more efforts should be made to assess "the relational aspects of space and life in the design and maintenance of student rooms". The COVID-19 pandemic through its safety protocols has disrupted people's travel behaviors and participation at social gatherings (Sehra *et al.,* 2020; & Ghanim *et al.,* 2022) and caused a significant decrease on campus visitations for students who live within a walk-able distance to campus (Yang *et al.,* 2023). We might deduce that walkability and biking coincide with better mobility, and a good network of open spaces, four broad policies were always used:



Graph-3; Campus design for "Walkability and Biking / better mobility" themes (the authors)

The University of Alabama, Tuscaloosa, aimed to provide a safe and beautiful campus that supports walking and bicycling by creating sidewalks and bike lanes along streets, enhancing corridors designated for pedestrian and bicycle use, providing bicycle storage and repair facilities, conducting safety education, enhancing streetscape and intersection changes, creating walkway extensions, and administering a bike rental program. the plan reduced pedestrian-vehicular conflicts by designing and locating pedestrian crossings, actively managing internal traffic, placing parking facilities at campus perimeters, restricting vehicular access to campus core, and converting inner roads to pedestrian and bicycle modes.

The UA campus design corroborates Ozgur & Sinem, (2017) assertion that pedestrian comfort and safety are given priority in campus planning. Most of the existing parking lots are situated at the campus periphery which could help reduce vehicular-pedestrian conflict and promote pedestrian safety. This could further support achieving the social interaction factor as more students, staff, and faculty use active mobility. However, the proposition to establish an additional parking lot at the campus core in the future may compromise pedestrian safety as vehicles may be attempted to move in and park at the heart of the campus dominated by active mobility.

Florida State University took a similar approach, with focus on improving pedestrian accessibility to the campus core and reducing vehicular access. The university's goal is to promote alternative transportation methods such as walking, biking, and public transit, while also making pedestrian and roadways safer for all. This is done through the relocation of vehicle parking lots to campus periphery, enhance the pedestrian roadways, additional width and safety designs for pedestrian and bicycle path, and restrict vehicular access at the campus Pedestrian Priority Zone.

North Carolina State University has proposed creating pedestrian-first paths and expanding bike and walking paths to promote safe bicycling and walking on campus. The university also provides incentives for students and employees who opt for walking and biking, while discouraging the use of private vehicles. By doing so, the university aims to reduce its carbon footprint and promote a healthier lifestyle among its community. The university is also making efforts to promote safe bicycling and walking on campus. They plan to convert internal streets into multi-modal, pedestrian-first paths and expand bicycle and walking paths. They will also create pedestrian crossings on perimeter roads.

Oxford University's Science Area is taking measures to improve landscaping and safety throughout the site. They plan

to enhance pedestrian and cyclist paths and manage campus vehicle movements to ensure safety.

Clemson University aims to create a safe, walkable campus by establishing a Pedestrian Priority Zone (PPZ) on campus, closing streets to general vehicular traffic, relocating parking to the campus periphery, and diverting traffic of inner roads to perimeter roads. The university has expanded the bicycle network on campus and adjoining city neighborhoods, located transit hubs for convenient access to the PPZ, and eliminated vertical impediments such as stairs and steep slopes on campus. These measures aim to promote social connection and create a safer, more accessible environment for students, faculty, and visitors by reducing the impact of vehicular traffic on campus, while providing safe and convenient alternatives for pedestrians and bicyclists.

All universities also emphasize the importance of creating open spaces that promote social interaction and inclusivity by encouraging community engagement and fostering a sense of belonging among students, faculty, and staff. Space design provided a safe and welcoming environment for pedestrians and bicyclists. The universities focused on creating pedestrian and bike-friendly paths and promoting alternative transportation methods to reduce vehicular traffic on campus. They also strive to create welcoming and aesthetically pleasing spaces to foster community among students, faculty, and staff.

Most of the universities, particularly North Carolina State University in its current plan, were deliberate in designing the campus to re-achieve better mobility and social interaction among the students:

> *" Different types of social interaction spaces are mixed throughout the neighborhood to help foster social wellbeing and create a dynamic, vibrant atmosphere throughout the day" and "all Campus Paths serve as the scenic and functional routes from which key campus locales can be viewed and also provide opportunities for impromptu social interactions" (NCSU; p.66 & p.179, 2023)"*

Radford University in promoting pedestrian safety stated:

> *"……enhance the street's visual quality and pedestrian safety by adding attractive and well-maintained landscaping to the medians in the center of the road and adding colored crosswalks at Tyler Avenue's intersections with side roads."*

The Radford University Parking plan map, Transit Plans map, master plan, and land use plan show all parking lots and on con-campus transit routes situated mostly at the campus periphery where the residential land use is designated. Pedestrian accessibility was promoted through the academic districts for students' safety and for healthy living.

Smart mobility as captured by the CUHK can be achieved through campus mobility policies such as park and ride system where people park their cars at a designated place and ride bicycle to campus. Encourage the use of shuttles, creating more bicycling & walking routes and provide ecstatic walking environment around the campus to influence walking are other few policy activities initiated by the university to protect the environment and prevent creating heat islands on campus. In this way universities are promoting active and healthy living while ensuring environmental sustainability on campuses.

IV. Summary of Findings

Except for UA Tuscaloosa, Clemson University, and Princeton University, all the seven other universities had some of their campus improvement plans during or post pandemic. The similarities and patterns that could be deduced from the thematic discussions above are that these universities are implementing various design strategies to prioritize the physical health and well-being of their students and staff after the COVID-19 pandemic. One such strategy is the creation of outdoor fitness facilities equipped with ultra-modern exercise equipment. These facilities provide students the opportunity to engage in physical activity while enjoying fresh air and open spaces to maintain their health and well-being.

Another pattern or strategy identified is the development of walking and cycling paths throughout university campuses with the aim of achieving social interaction/connection. These paths promote active transportation, making it convenient for students to walk or bike to their classes and incorporate physical activity into their daily routines. Universities are also taking conscious steps to ensure the safety of pedestrians and cyclists such as relocating parking lots to campuses peripheries and restricting vehicular access to campuses core.

To encourage active commuting options like walking or biking, universities are providing bike racks, bike-sharing programs, and pedestrian-friendly infrastructure, such as protected bike lanes. These initiatives promote physical activity as part of students' daily commutes. Outdoor sports and recreational areas, including sports fields, basketball courts, tennis courts, walking trails, and outdoor game spaces, are also being enhanced to encourage students to engage in outdoor activities and stay healthy. Universities are also transforming outdoor spaces into study areas by providing seating arrangements, Wi-Fi access, and charging points. These outdoor study spaces allow students to study, collaborate, and attend virtual lectures while enjoying the benefits of fresh air and natural surroundings.

Universities are designing campuses to promote energy sustainability by promoting active transport, creating green spaces, ensuring sustainable and smart mobility, conserving energy, and reducing greenhouse gas emissions. This strategy aims to prevent heat from being trapped in buildings and outdoor spaces, promote people's comfort, and reduce emissions.

Lastly, many universities are investing in creating green spaces, gardens, and campus landscapes to provide a serene environment for students to relax, meditate, and connect with nature. These green spaces promote overall well-being and contribute to a healthier campus environment.

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