Fostering Resilience in Karachi's School Transportation System: Urging Interdisciplinary DRR Strategies through the Lens of the Theory of Planned Behavior

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This work is submitted as a MS thesis in partial fulfillment of the requirement for the degree of

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Supervisor

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This is to certify that the

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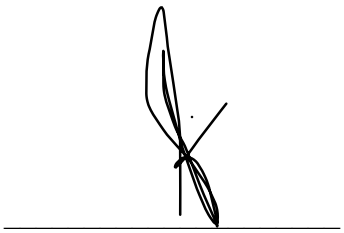

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DEDICATION

This thesis is dedicated to my beloved **Mother, Father and Siblings** who have been an inspiration throughout my life.

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ABSTRACT

This research focuses on the pressing issue of absence of a safe school transportation in the context of disaster risk reduction in Pakistan and considers school transportation issue a man-made hazard that poses risks to education, health, urban environment and life.

Despite the heightened susceptibility of students to transportation-related risks, there exists a notable gap in policies and regulations addressing this concern in developing countries. Utilizing a survey-based methodology guided by the Theory of Planned Behavior, the study gathered responses from 900 parents of school-going children and university students. The findings unveil paradoxical behaviors, wherein individuals opt for risky transportation modes as per past studies despite being aware of associated hazards. The study underscores the immediate need for comprehensive national DRR policy-based framework, enhanced infrastructure, and financial interventions to bolster school transportation safety in Pakistan. By adopting an interdisciplinary approach and drawing insights from successful models in developed countries, this research contributes significantly to the field of disaster risk reduction. The identified solutions are poised to bridge the existing gap in literature and pave the way for resilient urban development in the face of man-made hazards.

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Chapter 1

1. Introduction

1.1.1 General Background

Urbanization intensifies commuting, exacerbates congestion and environmental issues, straining a nation's transport system. A comprehensive, integrated, and intelligent strategy for city planning and transport management is necessitated by the rise in urbanization and motorization (Çetinkaya and Görer 1995). This approach able to tackle societal challenges prevalent in developing countries globally and to mitigate the direct impacts on sustainable development (Qureshi, Lu et al. 2007). A critical factor in achieving a convincingly green and sustainable city transition is a shift towards a sustainable transportation system, which is required to address these externalities (Faiz and Practice 1993). Furthermore, in today's fast-paced world of rapid urbanization and globalization, rising natural hazards and man-made disasters are causing increased casualties and economic damage globally (UNDRR-GAR 2022) and the consistent flow of people or goods have become an authentication of progress where urban resilience appear as a critical concern.

While urbanization is a global trend, it is a concerning point in Pakistan where cities expand without incorporating key environmental, social, and economic elements for sustainable development (Rehman, Shah et al. 2018). Pakistan also shares numerous transportation issues affecting people's mobility. Being one of the fastest urbanizing countries in South Asia, it faces mobility issues such as traffic congestion, road accidents, noise pollution from traffic, and overall environmental degradation (Rana and Bhatti 2018). This situation has profound negative effects particularly in major metropolitan cities and Karachi is one of them. In this study, we focus on Karachi, a city in Pakistan. Karachi faces numerous transportation issues symbolic of rapid urbanization. Karachi, a megacity, is at the forefront of a complex web of man-made risks, primarily stemming from its transportation sector. The city's rapid growth, constrained resources, and underdeveloped infrastructures have created a landscape that mirrors the dynamics of human-induced risks. The city's transportation sector is marked by overcrowding, traffic

congestion, substandard service quality, and poorly maintained vehicles, all contributing to a heightened risk environment. Furthermore, social risks such as limited mobility for women and widespread harassment on public buses add another layer of complexity to these challenges. These issues underscore the urgent need for strategies aimed at disaster risk reduction and the integration of such approaches into urban planning and development. This aligns with the broader global agenda of achieving sustainable development goals, particularly those related to building resilient infrastructure, promoting inclusive and sustainable urbanization, and fostering innovation (SDG 9 and SDG 11). (United-Nations (2016); Hoor-Ul-Ain (2019); Soomro, Memon et al. (2022))

As cities grow and evolve, they face a myriad of challenges that too with complexity from infrastructure development to disaster risk management. Narrowing down within discussed encounters, it has been observed that the issue of urban transportation systems taking a toll and has its severe impacts on people because modern societies rely heavily on transportation systems, their infrastructure, and their complex networks, which are instrumental drivers in promoting economic growth, social connectivity, and access to education. This interconnectedness between transportation systems and their infrastructure, layered with the potent mixture of hazards, risks and vulnerabilities, creates a critical crossroads in pursuit of sustainable development. In fact, urban regions worldwide have seen a shift towards automobile dominance in recent decades, diminishing their sustainability. This trend is particularly pronounced in developing cities, where rapid growth has led to a multitude of transport related issues, including congestion, pollution, accidents, decline in public transport, environmental damage, climate change implications, energy exhaustion, visual intrusion, economical and accessibility issues (Newman and Kenworthy (1999); Platform (2013); UNESCAP (2021); Mani and Goniewicz (2023)).

In focus to the Asia-Pacific region, much research has focused on the trailing context from the past decades. The region status as the world's most disaster-prone region (Guterres 2018), which faces unique challenges where urban areas are often characterized by high population densities and exposure to various probable hazards, risks, natural hazards and man-made disasters. Issues of urban sprawl, environmental degradation, and the need for holistic resilience strategies are particularly relevant here.

These issues are predominantly acute. The urgent challenge is to build resilience, which involves addressing the complex interconnections within our society, the environmental impacts of rapid urban expansion, and poor land management holistically, rather than focusing on transportation issues in isolation (Miao (2001); ESCAP (2013); Du, Wang et al. (2022)).

1.1.2 Background of the topic and need

This study delves into the city 'Karachi' of a developing country Pakistan, known as the city of lights, which stands as Pakistan's most populous city, economic center, and ranks as the world's eleventh most populous city (UNDESA 2021). Karachi, a metropolitan city of a middle-income country Pakistan boasts a diverse socioeconomic landscape (Jabeen, Jadoon et al. 2015). Transportation challenges are prevalent across all cities of Pakistan. However, the swift population growth in Karachi in recent years has resulted to an enormous demand for secure transportation methods. Recognized as one of Pakistan's most expansive metropolitan cities, Karachi spans an area of approximately 3,780 square kilometers (PBS 2017). The daily transportation needs of such a large populace present a significant challenge. The living conditions in Karachi, a city with an estimated population of approximately 17.2 million people, heavily rely on a robust transportation system, among other fundamental necessities (WPR 2023). The primary modes of public transportation in Karachi include buses, rickshaws, university shuttles, and private vehicles such as cars and motorcycles (Raza 2016). Karachi grapples with urban mobility challenges and lacks a functional public mass transit system, leading to a noticeable increase in private vehicle ownership due to rising incomes. This motorization, coupled with poor traffic management, inadequate planning, and land use, results in severe traffic congestion, environmental pollution, and longer travel times, impacting sustainable development adversely. Hence, adopting sustainable transportation principles is vital to prevent further ecological harm (Khan, Khan et al. 2016). The bustling metropolis of Karachi, characterized by rapid, unplanned urbanization, has seen a growing demand for a holistic sustainable transportation system as the city grapples with both natural and predominantly man-made hazards ((Hussain, Management et al. 2016); (Zaidi and Zafar 2018); (Fazal and Hotez 2020)). This

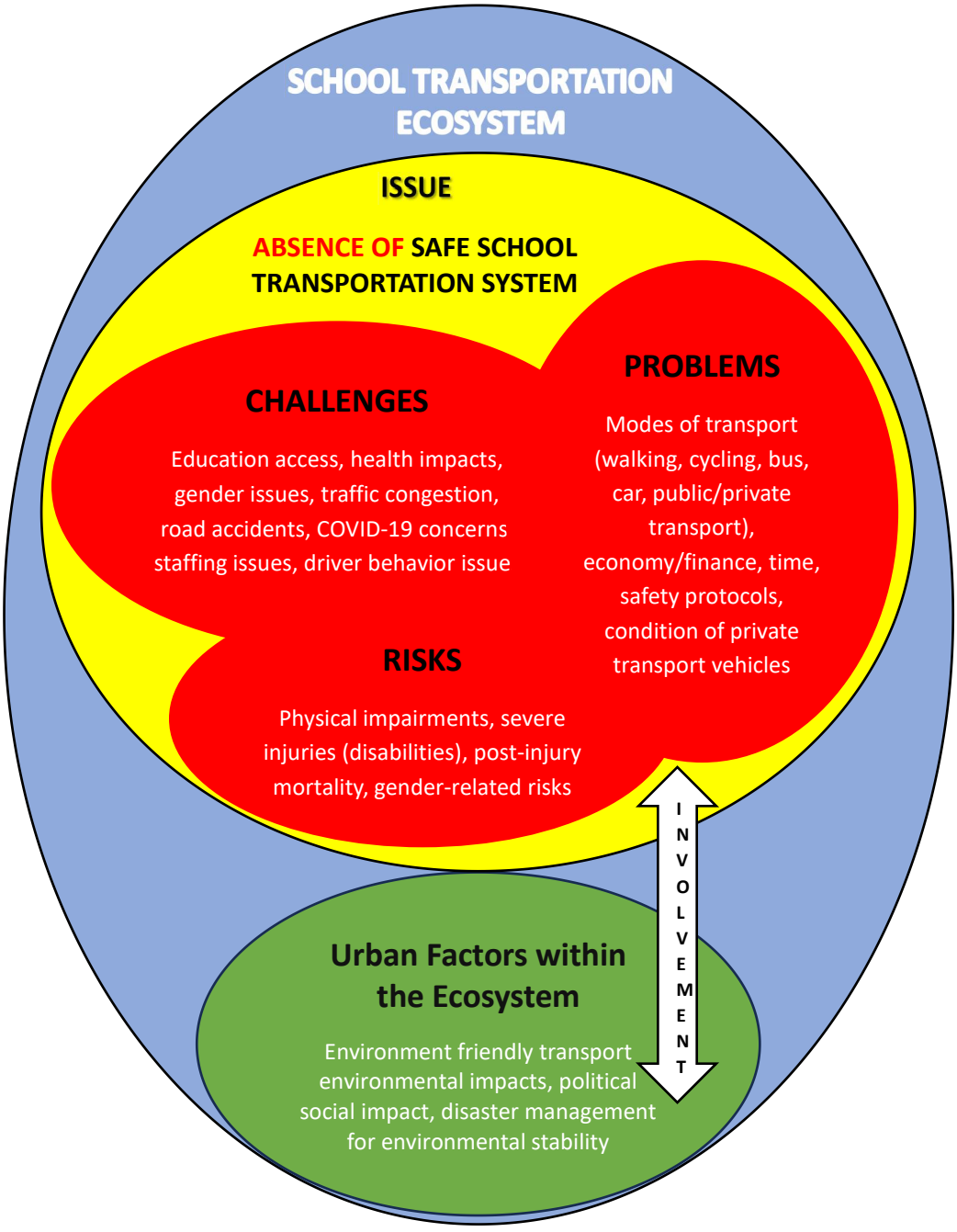
complex web of intertwined systems directly affects a multitude of stakeholders, with school university students at the forefront. The issue of safe and resilient transportation in general has been a subject of extensive discourse, where mobility is the key, yet, the specific intricacies of safe and resilient road transportation systems, keeping school or university students in consideration remained underscore. These transportation challenges not only pose significant threats to the education sector but often create hurdles for both male and female students, in fact, female students more so in their competition with male (Kendra 2000). As per the World Bank Open Data, in 2010, the literacy rate among Pakistan's youth (ages 15-24) was 71%, with 62% of the female youth population being literate (UNESCO(b) (2012); UNESCO(a) (2012)). Ensuring safe student commute in Karachi, Pakistan, is essential in the wider context of promoting fair education and sustainable progress in the region. Education, universally acknowledged as a cornerstone of a nation's development and a crucial step towards socioeconomic, scientific, and technological progress, is a key determinant of a country's advancement paramount to meet SDGs (UNICEF 2023). Understanding Pakistan's education and transportation systems, both facing significant challenges in access, quality, infrastructure, and safety, is crucial for contextualizing this study (GoP MoPDR (2017), MoFEPT-GoP (2017); MoFEPT-GoP (2018)).

1.2 Problem Statement

Students in Karachi, whether enrolled in school, high school, or universities, face significant transportation challenges, as evident by both recent and past studies. Historical data underscores the severe impact of transportation issues such as increased travel times, physical risks due to traffic congestion and travel costs coupled with road accidents. Variations in travel patterns based on environmental factors are also evident in the education travel of both males and females, which potentially affecting their school attendance and performance. The effects of traffic congestion and road accidents extend beyond immediate health concerns or gender dynamics. They affect in various aspects such as physical impairments, severe injuries (disabilities), and post-injury mortality outside school. This clearly indicates that the relationship between transport, health, education, gender dynamics and urban environment is interlinked (Razzak, Khan et al. (2013); Khan, Razzak et al. (2016); Humayun, Saleem et al. (2017); Ali, Mehry et al.

(2023)). Far from seeing a decrease, these man-made hazards are on the rise, leading to increased exposure to risks and susceptibility for students. This escalating situation further emphasizes the need for innovative strategies to improve the existing transportation structure and ensure safe, secure access to education for students.

Figure 1.1 Students Travel Condition



1.3 Research Gap

In Karachi, Pakistan, a rapidly urbanizing city known for its complex transportation system, the absence of a safe school transportation ecosystem is a significant challenge. While previous studies have explored influencing factors such as traffic congestion, mode of transport, and road safety, they have not fully addressed the relationship and the interconnectedness among these issues to mitigate them or the potential of a comprehensive 'safe school transportation ecosystem' from a Disaster Risk Reduction (DRR) perspective.

Recognizing this, our study adopts a holistic approach, viewing the school transportation ecosystem as a core driver of a network of interconnected aspects where safety and security are highly focused. We acknowledge that transportation is part of the broader urban ecosystem, and changes or disruptions in one area, like transportation, can have ripple effects on others (health, education, finance). The absence of a safe school transportation system is not just a gap; it's a man-made hazard that exacerbates these issues and challenges the resilience of the urban ecosystem. This study addresses two significant research gaps.

1. A comprehensive school transportation system that integrates DRR principles, responding to the need for a dedicated framework.
2. The Theory of Planned Behavior (TPB) has not been applied in this field (school transportation in Karachi) in the context of hazards/disaster management.

Our research fills these gaps by modeling students' travel intentions using TPB in the context of risk reduction, to contribute to a deeper understanding of student transportation challenges and potential solutions.

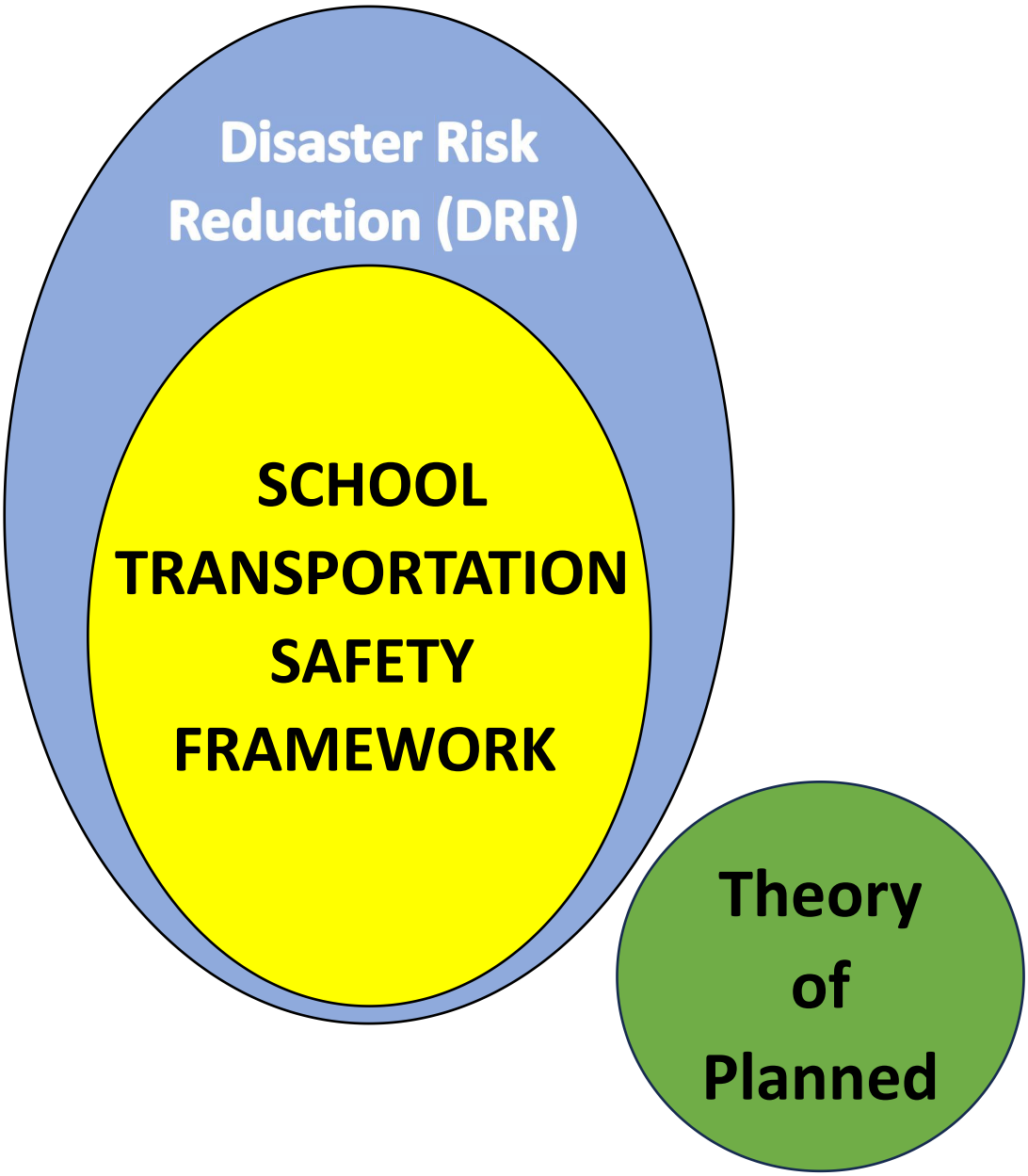


Figure 1.2: Identification of Research Gap

1.4 Research Question

In this study, the questions that serves as a foundation for the study, which seeks to address the following research concerns are:

1. Does the existing transport arrangement used by school and university students stand up to potential risks and hazards in terms of safety and resilience when accessing education?

(To analyze safety and resilience of the school transport arrangement to access education securely)

2. To what extent does the Pakistan School Safety Framework (PSSF) developed by the NDMA address the safety and resilience of the school transportation used by school and university students to access education?

(To highlight the lack of attention to school and university transportation used by students)

3. What strategies could enhance the safety and security of students' access to education by mainstreaming disaster risk reduction into urban planning, specifically considering the role of transportation infrastructure, amidst potential hazards and environmental and climate change issues?

(To explores the potential benefits of integrating DRR into urban planning. A forward-looking that considers the impact of potential hazards and environmental changes on the safety and security of students' access to education)

1.5 Research Aims and Objectives

Our aim is to delve into this intricate issue, focusing on the vulnerabilities and potential for transformation. We're particularly interested in how students, who are central to our future and susceptible to transportation-related risks, navigate these challenges. This research underscores the connection between transportation systems,

their inherent risks, and the impact on educational access. The study goal is aligned by following the objectives below:

1. Assess the existing policies or frameworks related to safe school transportation in Pakistan and other similar countries.
2. Understand the current issues with student transportation by analyzing the hazards and risks involved, and studying past literature.
3. Investigate the relationship between various factors and people's perceptions related to safe school transportation.
4. Propose recommendations based on the findings to foster a safer commuting environment for students, addressing the identified problems and promoting their overall well-being.

1.6 Research Significance

This research aims to develop a comprehensive understanding of the school transportation ecosystem, particularly in urban settings like Karachi. It explores the influence of urban environmental factors, transportation involvement, and risk-taking propensity on students' travel behavior. The findings from this study could guide policymakers in enhancing the school transportation ecosystem, transitioning from a system that lacks safety mechanisms to one that is resilient and sustainable. This could positively impact students' access to education and overall well-being. This research reflects three different significances, which are below.

1.6.1 Methodological

The methodological significance explains the new methods which are adopted and discussed in the current research. The study incorporates process involving Theory of planned behavior, integrated with established independent variables. The study employs Partial Least Squares Structure Equation Modeling (PLS-SEM) as multiple hierarchical regression analysis using SmartPLS software.

1.6.2 Practical

The current study employs multi-disciplinary approaches to evaluate the challenges and risks within the school transportation ecosystem, including the influence of urban environmental factors and the involvement of transport in access to education. A comprehensive dataset will provide a broad understanding of how these factors influence the challenges and risks faced by students. The positive correlation between the environmental influences, transportation involvement, and risk-taking within the current system motivates stakeholders to improve safety mechanisms and address challenging problems. The urban environment, both natural and man-made, influences the school transportation ecosystem, which in turn affects access to education. Encouraging improvements in the school transportation ecosystem by providing safer and more efficient transport options, and understanding the significant relationship between these factors and the challenges faced by students, can contribute to meeting the United Nations Sustainable Development Goals (UNSDGs).

1.6.3 Theoretical

Under the umbrella of disaster risk reduction (DRR), this research enriches the Theory of Planned Behavior (TPB) by applying it to the school transportation ecosystem in Karachi. It considers independent variables such as urban environmental factors, transportation involvement, and risk-taking propensity. This comprehensive view of the school transportation ecosystem provides detailed insights at a system level, demonstrating how these factors influence student challenges and risks. The study also highlights the role of resilience and sustainable development in the urban landscape, contributing to the United Nations Sustainable Development Goals (UNSDGs). This research, grounded in the context of Disaster Risk Reduction (DRR), enriches the Theory of Planned Behavior (TPB) by applying it as a lens to examine the school transportation ecosystem.

Chapter 2

2. Literature review

This chapter embarks on a thorough and detailed investigation to fulfill the research objectives. It includes examination of existing policies in Pakistan, comparable countries, and developed nations, with a specific emphasis on specific measures for secure school transportation. A thorough literature review of previous studies is conducted to comprehend how the issue has been previously tackled, along with current international reports, government reports, and documents that amalgamate knowledge from various sectors such as transportation, environment, education, health, and disaster science, providing a comprehensive understanding of the issue in urbanization through diverse search strategies. The chapter further elaborates on the theoretical support employed in this study correlation between environmental concern, propensity for risk-taking, and involvement in transportation among parents of school students and university students, using a survey questionnaire.

In the evolving field of Disaster Management Science, the focus is often on mitigating risks and enhancing resilience in various systems. One such system, which has been largely overlooked in the discourse, particularly in the context of developing countries, is the school transportation ecosystem. This research aims to bring this issue to the forefront, highlighting the need for a safe and efficient school transportation ecosystem as a crucial component of urban resilience. As global urbanization trends are on the rise, with an increasing number of individuals relocating to urban areas, it is estimated from the 2018 data that urban dwellers are constituted about 55% of the global population (United-Nations 2018). While urbanization can be a positive sign of economic progress, it also brings about socioeconomic challenges. The surge in economic opportunities in urban areas has drawn individuals from impoverished rural regions, leading to a rise in urban populace (Khan, Saboor et al. 2016). This, in turn, escalates the need for transportation, subsequently resulting in increased vehicle emissions and road calamities. The current scenario, however, also reveals an escalating loss of life inclination due road traffic which is a man-made problem (Sikdar 2005). Shockingly, the incidence of such fatalities in low- and middle-income nations is

reported to be triple that of high-income countries (WHO 2018). Recognizing these implications, the United Nations formulated the Sustainable Development Goals (SDG) in 2015 (United-Nations 2015 b), comprising 17 goals, each with specific targets aimed at fostering a sustainable future. SDG 11, one of the Sustainable Development Goals, is centered on urban sustainability, with one of its objectives being to establish 'safe, affordable, accessible, and sustainable transport systems for all' (United-Nations 2015 a). Universally this goal not only emphasizes the accessibility of transportation but also underscores the importance of ensuring the safety of commuters, passengers, and pedestrians of the community. To curb such alarming situations, developed countries have established and implemented sustainable transport policies, but there is a need for consensus on the imperative of policy intervention, along with a strategic, consistent, and stable policy landscape in developing countries (Lah 2019). Inclination of transport problems also has a significant effect on students. Various legislation have been enacted, encompassing transport policies that have particular perspective of mobility to and from school as a concept (Katko and Policy (2006); Yang, Kim et al. (2003)).

This study researches into the repercussions of absence of safe school transportation ecosystem, a human-induced hazard, on the facets of students' education, health, and overall well-being. It highlights the complex relationship between this issue and the disruptive urban ecosystem, which is a hotbed for both natural calamities (air pollution, heatwaves, urban flooding, precipitation) and anthropogenic hazards (political, social). The research identifies key variables from environment consciousness, engagement in transportation, propensity of taking risk and corelate them with the theoretical framework of planned behavioral theory guiding the study towards the need for a comprehensive safe school transportation ecosystem. It underscores the importance of resilience in this built environment in line with the United Nations' Sustainable Development Goals. The overarching aim is to foster the development of safer, more sustainable school transportation ecosystem, thereby aligning with the principles of disaster risk reduction and promoting risk-informed sustainable development.

2.1 Policies, Regulations and Frameworks

The accessibility of education is a fundamental right, a cornerstone of individual empowerment, and a key driver of socioeconomic development (UNESCO) (Pakistan) and also necessary to achieve the Sustainable Development Goals (UNICEF 2023). To comprehensively understand safe school transport, this study first assesses the existing relevant policies or frameworks related to safe school transportation in Pakistan and reviews similar policies in other countries. A review of national and regional laws, regulations, and guidelines is essential.

Despite the recognition of educational accessibility in Pakistan's educational policies, significant gaps in service provision, including transportation, pose a major barrier to accessing education. School transport has been mentioned as a heavy expenditure borne by parents. Proposals for actions have been made to provide school transport, particularly to special education institutes and for girl students, to ensure their social security. However the implementation has been inconsistent (Education (2009); MoFEPT-GoP (2017); MoFEPT-GoP (2018); SINDH (2020) (2011)). Nevertheless, the challenges extend beyond the education sector. Under the auspices of the National Disaster Risk Reduction (NDRR) policy which was formulated in 2013 (NDMA 2013) with focuses on prevention, mitigation, and preparedness aspects of disaster risk reduction (DRR), in response to the dire need for a comprehensive school safety initiative, especially in light of the tragic loss of 19,000 children in the 2005 earthquake due to widespread collapses of school buildings the Pakistan School Safety Framework (PSSF) was formulated (NDMA 2017). The PSSF is aligned with the global commitment to advancing children's rights and aims to safeguard children's interests in times of disasters and promote a safe learning environment for students, teachers, and school staff. It follows a structured approach to understand hazards and develop effective response strategies to cope with emergency situations, including the transport of disabled students (differently able students) and the provision of first aid transportation for injured students. Importantly, despite having educational policies in place, the specific area of student transportation often falls by the wayside in policy discussions. This oversight is particularly concerning given the country's vulnerability to both natural and

human-induced hazards. In 2017, the National Transport Policy was also introduced, which highlighted the importance of a safe, secure, and accessible transport system for all citizens, including school students (GoP MoPDR 2017). The National Highways and Motorway Police Pakistan has devised document in which they identified the traffic knowledge grade-wise for children. It includes road safety guidelines for classes I to XII in their syllabus. Specifically addressing school-related aspects, the syllabus provides general guidelines for road safety so that students can understand regarding traffic safety and rules and regulations to be followed. Additionally, it not only highlights Road Safety Tips for the school category of road users who commute using school transportation but the syllabus also emphasizes the importance of using Police Helpline 15 or NH&MP Helpline 130 to report instances where drivers fail to adhere to road system norms, ensuring prompt attention to such issues (NHMP). Despite these advancements, the specific issue of school transport safety seems to have been overlooked in these policies. This is not a critique, but rather an observation that underscores the importance of our research plays in addressing the absence of a nationwide regulation via policy or framework for holistic safe school transport in Pakistan. None of these policies address the issue of a safe school transportation ecosystem. Despite the absence of a nationwide policy or framework for a holistic safe school transport in Pakistan, the Khyber Pakhtunkhwa Province is witnessing a significant transformation. A World Bank project is currently underway to upgrade approximately 650 kilometers of rural roads, with a primary focus on improving school accessibility gaps as safety. This initiative is expected to benefit nearly 65,000 schoolgirls across five districts, providing them with faster, safer, and more reliable commutes to school. However, it's important to note that while this project enhances the physical infrastructure necessary for school commutes, it does not constitute a comprehensive safe school transport ecosystem in itself. It serves as a testament to the potential impact of regional efforts in enhancing school transport mobility, particularly in areas where nationwide policies are lacking (World-Bank 2022). From infrastructural deficiencies to safety and security risks, the complexities that contribute to this issue are numerous. These challenges extend beyond the education sector, impacting the overall safety and well-being of students during their commutes.

It is enlightening to compare this situation with similar countries. The issue of safe school transport is addressed with varying degrees of achievement across different countries. For instance, Afghanistan faces unique challenges due to conflict and traditional norms, particularly affecting girls' access to education (Afghanistan). The lack of numerous facilities in schools along with geographical barriers, insufficient transportation is one of the main obstacles to education (Naqawi, Rajath et al. 2022). In one of similar developing countries Bangladesh, The Bangladesh Road Transportation Corporation (BRTC) is committed to providing quality bus services for intra-city and inter-city routes, as well as specialized services for public employees, school buses, and women's buses in the capital and most developed metropolitan city Dhaka ((BRTC)). Despite these efforts, transportation challenges persist, particularly absence of school transport related policy/framework also observed (Bari, Newaz et al. 2019). Whereas India have implemented specific school bus safety laws and rules, with India's Central Board of Secondary Education issuing additional guidelines on safe school transport (India 2017). The government has developed school bus safety laws and regulations, such as mandating GPS and CCTV in school buses and installing CCTV in school grounds (Bus) for ensuring comfort for both students and their parents through a sense of safety and security. Advantages encompass punctual arrival at schools, lessening the release of pollutants from vehicle exhausts, and mitigating traffic congestion. Furthermore, it appears that there isn't a specific policy or framework dedicated solely to school or university student transportation in Iran but Iran's transit-focused road policy, with initiatives like new transit corridors and digitalization of transport procedures, indirectly impacts student transportation by offering efficient transit options (IRU 2022). In Nepal, student transportation is indirectly addressed through broader transport policies. In the context of student transportation in Nepal, research indicates a need for policy attention. Despite a provision for student discounts on public transport, its inconsistent implementation suggests a gap in policy enforcement. Studies highlight a demand for improved public transport, indirectly impacting student commute. However, specific policies addressing student transportation are not evident. This underscores the need for focused research and policy formulation in this area (Pokharel and Acharya 2015); (Parajuli and Haynes 2018); (Mishra, Aithal et al. 2022)). In Sri Lanka, student

transportation is an area that appears to be indirectly addressed within broader transportation and logistics policies. While there are studies and initiatives aimed at improving the overall transportation system, specific research or policies focusing solely on student transportation lacked in the literature. This highlights a potential area for further research and policy development (Logistics 2020); (Wijesinghe, Gunasekera et al. 2022).

In established school transport systems such as those in the United States, Canada, Australia, Belgium, Germany, New Zealand, Japan, and the United Kingdom, a robust regulatory framework is central to ensuring the safety of students during their commute. Countries implement regulations governing bus design, driver qualifications, and motorist behavior around schools and school buses. For instance, regulations in Australia, Belgium, and Germany mandate the use of warning signals by school buses during loading or unloading, accompanied by a requirement for reduced traffic speeds. New Zealand enforces a maximum speed limit of 20km/h around school buses, while Japan and the United Kingdom mandate slow driving when passing a school bus. In the United States and Canada, strict laws require motorists to stop and wait while students enter or exit a school bus from both directions. Additional regulations often extend to school zones, where speed reductions are mandated during school hours. Vigorous enforcement is crucial, and in the United States, collaboration between local, state, and school officials with law enforcement ensures compliance with traffic safety laws. Various countries have adopted institutional frameworks to govern school transport, reflecting their size and government model. New Zealand employs a centralized national institutional framework overseeing vehicle standards, licensing, and service operator monitoring. This includes active police involvement in educating students on safety, enforcing vehicle requirements, and collaborating with the Bus and Coach Association of New Zealand. In contrast, the United States follows a decentralized institutional framework, where states refine or exceed national standards, with school districts administering services, often outsourcing to private operators if necessary. Industry advocacy groups play a vital role in supporting and contributing to the overall effectiveness of the school bus system, embodying a commitment to Disaster Risk Reduction (DRR) by prioritizing preparedness, resilience, and the safety of students in

the face of potential challenges (Deng and J Kurgan 2012). While developed countries have made significant strides in safe school transport through leveraging advanced technologies and robust policies to ensure the safety and well-being of students, there's still much work to be done, especially in developing countries where resources are often limited (Deng and J Kurgan (2012); Hopson, Lidbe et al. (2022)).

The study identifies the absence of school transportation ecosystem considerations in national education, disaster risk reduction, transport, and urban policies, as well as in the Pakistan Safe School Framework based on DRR policies. Such an analysis is vital within the scope of disaster risk reduction (DRR). This reveals as a gap (root cause of the deteriorate school transport ecosystem). As a critical component of DRR, it aids in identifying susceptibilities, its severity and effective measures that help mitigate the risks associated with commuting to school in a developing country. It provides valuable insights into the diverse strategies that various developing and developed countries implement to improve school transportation ecosystem. This policy analysis is crucial to understand where we stand and what gaps need to be filled comparing with developed countries that have worked for this in bringing policies, rules, regulations or SOPs for safe school transport ecosystem.

2.2 School Transportation and Challenges

If delving deeper into transportation challenges further, school transportation aspect often gets overlooked in urban complexity. Among the major consumers of transportation are students. Transport to and from school or university is important to society since it serves a vulnerable age group. Because of this, its construction demands meticulous design and the highest level of safety. School transportation encompasses various modes of student commute, including walking, biking, and the use of private cars, buses, and taxis where direct key stakeholders include students, parents, teachers, drivers, and bus attendants, all of whom play vital roles in ensuring student safety. The education as awareness about safe travel rules begins at an early age, with constant reminders about appropriate behavior during the journey (Morfoulaki, Kotoula et al. 2015).

School transport has a continuous and long-term role and impact on the lives of children from preschool through high school (Jennissen, Denning et al. 2022). The issue of school transportation in urban areas emerges as a significant and critical concern. The safety and security of vulnerable group ‘students’ during their commute to and from school is a matter of paramount importance (Sakellariou, Kotoula et al. (2017); Bhatnagar, Gupta et al. (2022)) due to exposure to numerous potential hazards and probability of harmful risks ranging from road accidents involving school buses or other transport vehicles, vehicle failure incidents, injuries from road traffic in school vicinity, road traffic safety failures, injury-induced mortality e.tc. Such events disrupt all aspects of daily life of both students and their parents in addition pose a serious threat to the well-being, safety and life of students (Nasrudin and Nor (2013); Kim, Francis et al. (2018); Mohammed, Ambak et al. (2019)).

Ensuring the safe school transportation is a pressing issue, particularly in lower to middle-income countries like Pakistan. These countries, while striving for growth and development, often grapple with resource constraints and policy gaps that compromise the safety and security of students travelling to and from school or university within vulnerable road transportation arrangements. Therefore, addressing these issues in the context of Pakistan not only contributes for national progress but also to the broader resilience-building efforts in the region. While specific data on the domain of school transportation disasters in Asia is not readily available, it is evident that potential hazards and emerging risks induced by humans pertaining to the subject, are on the rise (Razzak, Khan et al. (2013); Khan, Razzak et al. (2016); Humayun, Saleem et al. (2017); Ali, Mehry et al. (2023); Aliyas, Lak et al. (2022); Dghaim, El Kouatly Kambris et al. (2020); Bari, Newaz et al. (2019)). It has been widely argued that the importance of safe and secure school transportation in ensuring the overall well-being and academic success of students cannot be overstated (Donoughe and Katz 2015); (Edwards 2022); (Bhatnagar, Gupta et al. 2022)). This is a widely accepted concept in educational and policy circles (Dghaim, El Kouatly Kambris et al. 2020);(Yousefzade-Chabok, Azari et al. 2021);(American Academy of Pediatrics Committee on Injury, Poison et al. 2007);(Chingos and Blagg 2017);(Abbas, Basit et al. 2022);(Pogotovkina, Volodkin et al.

2019);(NHTSA)). It is widely recognized that the availability of reliable school transportation plays a crucial role (Sakellariou, Kotoula et al. 2017); (Rizwan 2022).

2.3 Hazardous School Transportation in Karachi, Pakistan

In this multifaceted landscape, the journey of students seeking access to education which is the basic right of children unfolds, offering a compelling lens through which to view the pressing challenges and imperatives of our time (Kett and Deluca (2016); UNICEF (2019). It is a journey where their safety, security, and the very accessibility of education hang in the balance. This issue is not confined to urban city of any one region but is a global concern, with Asia being no exception. While existing studies have assessed various factors challenging for students' commute to and from school or university, this research takes a novel approach by examining the school transportation system from a disaster risk reduction perspective. Previous studies have explored issues such as gender disparities, mortality risks, injury prevalence, road accidents, and economic challenges as influencing factors. However, past studies often fail to provide a comprehensive view of the student transportation ecosystem, particularly in the context of mainstreaming disaster risks reduction. This study addresses the issue by advocating DRR for a school transport ecosystem with the intention to contribute to a broader understanding of the aftermaths of potential risks, hazards and challenges faced by students due to their unsafe commute to and from school and emphasize the need for proactive solutions for sustainable development.

Moreover, noteworthy among the past studies that addresses influencing factors one of the work by Razzak, Luby et al. (2004), which meticulously investigated injury-related mortality in Pakistani children under 5. Their findings unveiled motor vehicle crashes as a predominant cause, underlining the urgent need for preventive measures, especially during peak school hours. The study found that injuries are a leading cause of disability and premature mortality of children under 18 dying annually due to injuries deathtrap. A research endeavor spearheaded by Razzak, Khan et al. (2013) delved into the issue of injury-induced mortality among children under 5 in Pakistan. The study underscored that injuries are the third primary cause of fatalities in children aged 1-5,

with the incidence being doubly high in rural regions than urban. Road Traffic Injuries (RTIs) emerged as a substantial risk factor. The main findings compelled researchers to propose measures such as the imposition of lower speed limits in residential and school locality, enforcement of helmet laws for child motorcyclists and bicyclists, and the need of safe school transportation to curtail RTI-related deaths and disabilities. Khan, Razzak et al. (2016) directed their focus towards the evolving mobility patterns of children. The research revealed that children's independent mobility increases after the age of 10, initially as pedestrians and cyclists, and later as drivers. The study focused on children aged 10-14, found walking as the predominant mode of travel to school for both genders. Unveiling a gender and age disparity, their study shed light on parental restrictions on mobility, particularly impacting girls. The study does not explicitly state why girls face more mobility restrictions. However, it can be inferred from the cultural and societal context of Pakistan, where the study was conducted (Faiz, Woodcock et al. (2018) ; Adeel, Yeh et al. (2017)). Another lens on transport challenges comes from the work of Humayun, Saleem et al. (2017) who scrutinized the difficulties faced by female students in Karachi Medical and Dental College (KMDC) and the University of Karachi (UoK). Their findings, exposing the prevalence of stressful travel and instances of physical and verbal harassment during commutes, underscore the need for improved safety measures to bring in a student transportation. Ali, Mehry et al. (2023) focuses presented a pilot study assessing road traffic injury hazards for school children in Karachi. Regardless of the mode of transport, the study illuminated the exposure of children to numerous road traffic injury hazards, emphasizing the pressing need for public health initiatives to minimize these risks. It was observed that both pedestrians and passengers exhibited risky behaviors on the roads. In the realm of technology, Raza, Khan et al. (2021) explored students' behavior towards ride-sharing services in the context of Karachi, addressing safety and security concerns as significant determinants. This emphasizes the pivotal role perceived risk plays in shaping students' behavioral intentions, calling for secure services to boost ride-sharing usage. Ullah (2023) and his team ventured into exploring the potential of demand-responsive transit (DRT) in tackling transportation challenges in Karachi. Not only did their study reveal DRT's appeal to the working class, but it also highlighted students' preferences for modes with minimal waiting times and

low cancellation fees and a safer commuting option, particularly for students facing harassment on public transport. Currently, a limited number of studies have revealed school transportation issues in Karachi therefore in this study we also incorporated research from other cities of Pakistan. Turning the spotlight on environmental impacts, Zafar, Anjum et al. (2015) scrutinized the environmental consequences of school transport in Islamabad. The study, pioneering in its focus, outlined the challenges arising from the shift of private schools and proposed sustainable solutions for environment. However, safety concerns currently hinder the implementation of these solutions. Ensuring the safety and security of students extends beyond city boundaries, Ali and Fatima (2016) examined safety measures in secondary schools in Islamabad, revealing a shared commitment, irrespective of gender, to implement safety measures. Along various safety measures, severe transportation accidents, and acts of violence also enlisted. This collective dedication underscores the creation of safe and conducive learning environments. Shifting focus to Khyber Pakhtunkhwa province, two studies seem to focus on the broader theme of hazards risk management (Shah, Gong et al. 2020); (Shah, Gong et al. 2020); Shah, Wu et al. (2021) spotlight the vulnerability of schools to flood risks, advocating for robust disaster risk management. One of these studies touches on transportation issues, shedding light on the accessibility challenges triggered by specific road access concerns, highlighting the direct link between accessibility and mobility.

2.4 School Transportation in developing countries

In developing countries, currently numerous numbers of research have been done on the subject. In Dhaka city of Bangladesh and Colombo of Sri Lanka, a significant number of students in residential areas rely on rickshaws for transportation due to the high concentration of schools and colleges whilst facing various factors that influencing multiple transportation challenges. This reliance, coupled with heavy traffic jams, often results in students being unable to reach their destinations on time along that being a female student also increases the likelihood of getting harassed and these female students find it difficult to speak up against sexual harassment, whether it occurs inside the car or during their walk. Consequently, the parents of female students often consider it safer to halt their education and arrange for early marriage. Even emergency services

like ambulances and fire trucks face delays (Yeasmin 2019); (Yasir, Ahmad et al. 2022); (Urmi, Rahman et al. 2022); (Abedin, Kamau et al. 2016); (Madhuwanthi, Marasinghe et al. 2016)) and thus a proper system requires for students in order to improve present safety conditions (Sadeek, Chowdhury et al. 2018). India possesses one of the world's largest and densest transportation networks, most roads are in poor condition, urban traffic is congested, public transportation is unreliable and dangerous, and intra-regional connectivity is inadequate (The-World-Bank 2014). The hazards school children confront on a daily commute are caused by a variety of factors, including inadequate road infrastructure, relatively dangerous automobiles, lax enforcement, and irresponsible road user conduct. Both private travel and school-affiliated transit have these dangers (SaveLIFE Foundation India 2021). Study by Aliyas, Lak et al. (2022) explores the decline in Active School Travel (AST) among children in Iran, particularly in the context of increasing automobility and rapid urbanization. The research focuses on understanding the environmental, household, and child factors that influence AST, and how these factors relate to children's emotional perceptions. The study found that safety concerns, traffic issues, and distance were the main barriers to AST. Interestingly, parents' perceptions of crime and traffic safety were positively associated with higher levels of AST. The study concludes by emphasizing the need for incorporating AST into school plans as a health promotion strategy and improving safety and distance perceptions to encourage children to walk or cycle to school. Studies reveal a need for improved student transportation in Iran. University of Tehran students rely heavily on public transport but seek better systems and alternatives like bike-sharing (Pazhuhan, Soltani et al. 2022).

2.5 Theoretical Support

This study employs the Theory of Planned Behavior (TPB) to comprehend students' intentions relating to safe school transportation. The study seeks to extract insights pertaining safety and security aspects. Three independent variables (environmental concern, involvement of transportation, risk taking propensity) integrating through TPB constructs proposed to serve as an effective model for understanding and predicting travel behavioral intentions within this specific context.

2.5.1 Theory of Planned Behavior (TPB)

Theory of Planned Behavior (TPB) (Ajzen 1991) stands as one of the most extensively utilized models for behavior prediction. The TPB posits that behavior be able to be predicted through behavioral intentions, while these behavioral intentions be able to be determined directly by attitudes toward the behavior, perceived behavioral control (PBC), and subjective norms (SN) ((Ajzen 1985);(1991); (Fishbein and Ajzen 1977)).

In the realm of environmental psychology, various studies have explored how the predictors within the TPB influence individuals' intentions regarding car usage, as well as their choices in favor of public transportation or alternative modes of transport, instead of relying on personal vehicles (Harland, Staats et al. 1999, Bamberg and Schmidt 2003, Bamberg, Hunecke et al. 2007, Hsu, Boarnet et al. 2019). In a study conducted by Donald, Cooper et al. (2014), the argument is made that enhancing the prediction of mode choice can be achieved by incorporating environmental concern as a factor. Their findings reveal that environmental concern exerts an indirect influence on car use. Furthermore, an expanded iteration of the Theory of Planned Behavior (Paul, Modi et al. 2016) introduces environmental concern (Dunlap and Jones 2002) as a fourth predictive element. Additionally, it incorporates risk-taking propensity as a moderator, influencing the relationship between behavioral intention and the other three predictors.

In the context of this model, Attitude is characterized by the degree to which an individual holds a favorable or unfavorable assessment of a specific behavior. Subjective norm on the other hand, pertains to the perceived social pressure exerted on an individual to either engage in or abstain from said behavior. It is important to note that two distinct categories of social norms have been identified (Ajzen 2002): injunctive norms, which concern the societal approval or disapproval of the behavior, and descriptive norms, which focus on the actual behavior exhibited by others in a similar context. Finally, Perceived Behavioral Control is defined as the perception of how easy or challenging it is to execute the intended behavior.

Environmental concern is a measure of individuals' awareness of environmental issues and their personal commitment to contributing to their resolution (Dunlap and Jones 2002). It specifically targets contemporary environmental challenges within the

transportation sector, under the assumption that "attitudes towards specific environmental topics ultimately reflect a broader environmental attitude, often referred to as environmental concern" (Dunlap and Jones 2002, Thomson, Towl et al. 2016). In support of this notion, Donald, Cooper et al. (2014) argue that incorporating environmental concern into the prediction model for mode choice can yield valuable insights. They contend that environmental concern introduces additional beliefs beyond the three classic constructs of the TPB, and indeed, their research reveals that EC exerts an indirect influence on car usage. Consequently, we have adapted the model presented by Paul, Modi et al. (2016), who also found environmental concern to be a predictive factor, particularly in the context of green consumption. In our study, we have included environmental concerns as a component of the model. However, it's important to note that the literature features an ongoing discourse regarding the appropriate measurement of environmental attitudes. For example, Harland, Staats et al. (1999) employ items that closely resemble our conceptualization of environmental concern (e.g., "I am concerned about the state of the environment") in their assessment of environmental involvement.

The TPB has widely been used in recent studies as already has mentioned above, especially for vulnerable transportation (Shaaban and Maher 2020, Hauslbauer, Schade et al. 2022). The theory of planned behavior is bestowing meaningfulness, explanations, and understanding to this study and helps predict facts of the latent dimension of attitude towards the vulnerable transportation system. That is why I grounded the TPB in this study to examine the variables' impact on stakeholders' perception. The enormous findings of our study undoubtedly making advance the theory of planned behavior.

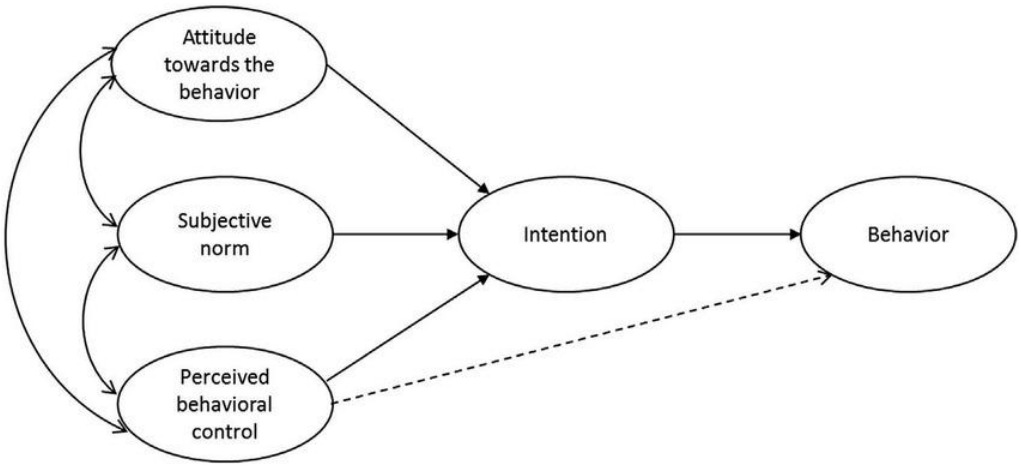


Figure 2.3: Theory of planned behavior

Notw: The model presents how behavior is influenced by intention which could be based on three interconnected factors (Ajzen 1991)

2.5.2 Theory of Planned Behavior (TPB) in Transportation

Theory of Planned Behavior (TPB) and its application to transportation behaviors. Researchers has investigated the impact of individual attitudes, subjective norms, and perceived behavioral control on transportation choices. The Theory of Planned Behavior (TPB) (Ajzen 1991) has been proven to be applicable in the field of transportation, usually in modeling behavioral intentions within the field of travel and transportation research. This includes studying intentions related to public transport usage (Heath and Gifford 2002); Javid, OKAMURA et al. (2015), bike-sharing (Kaplan, Manca et al. 2015), walking choice (Sun, Acheampong et al. 2015), low-cost carrier utilization (Pan and Truong 2018), and the adoption of electric vehicles (Haustein and Jensen 2018), among other areas of investigation. From one of the studies, Shalender and Sharma (2021) utilizing an extended version of the TPB model in order to predict the adoption intention of electric vehicles in India. This research provides valuable insights into the factors influencing consumers' decisions to adopt ecologically friendly transportation options. In study by Si, Shi et al. (2019), aimed to holistically comprehend the status of application of the TPB in environmental science as of knowledge domain visualization perspective, the results showed that the TPB was identified as one of the

most commonly applied behavioral theories to multiple primary research topics involved mainly green consumption, climate and the environment, saving and conservation, and sustainable transportation, particularly in relation to environment related behavior. Moreover, Jin, Guo et al. (2021) conducted an in-depth analysis of the influencing factors of driving behaviors; a complex also multidisciplinary research area, categorizing them into five zones from mistakes, lapses and slips, violations, driving experience, to safety attitude and awareness. The research provides valuable insights by using the TPB into the factors that influence driving behaviors exclusively bad driving behaviors which threatens the safety of road users should be refrained.

Similarly, in Pakistan, the research that applies the TPB by Brohi, Kalwar et al. (2021) to understand the behavioral intention behind using public transportation services, particularly in the context of Karachi's Circular Railway, provides a compelling exploration into the behavioral intentions influencing usage of transport. It offers a comprehensive analysis and valuable insights into commuter behavior, setting a benchmark for similar studies. The study of Javid, Abdullah et al. (2022) employing the TPB to measure travelers' preferences for electric vehicles in Lahore, Pakistan, is also an outstanding piece of research which provides a comprehensive understanding of the factors that affect the adoption of electric vehicles, making a significant contribution to the existing knowledge in this field.

None the less, multiple authors (Heath and Gifford (2002); Murtagh, Rowe et al. (2012); Sun, Acheampong et al. (2015); Frater, Kuijer et al. (2017); Stark, Berger et al. (2018); Siahaan, Tjahjono et al. (2020); Ranaei, Hassani et al. (2021); Ranaei, Sahab Jahanlu et al. (2022)) rationally managed to explore role of TPB in student's school (primary, secondary, university) travel and provides a compelling argument for the application of the TPB in the field of transportation significant to predicting student's behavior in school travel modes (walking, car, bicycle, bike-sharing), environment factors (safe traffic, road accidents, reduce car usage). Those researches demonstrate how the TPB can be used to predict children's school travel behaviors by emphasizing the importance of both intentional and habitual processes in shaping these behaviors. Even parents' car use behavior precisely relates with their children's school trips (Ehteshamrad, Saffarzadeh et al. 2017).

2.5.3 Theory of Planned Behavior (TPB) in Disaster Management

The Theory of Planned Behavior (TPB) has been discovered to be useful in the subject of disaster preparedness science and management, with various scholars contributing to its development and use. As we know that the theory by Ajzen (1991) proposed that *intentions* might impact behavior and have the potential to be influenced by three factors: attitude, subjective norms, and perceived behavioral control. The creator, Ajzen (2020) in his latest work, found that the theory has been effectively applied to predict and explain a wide range of behavioral domains. This probably exhibits in a broad range of sectors, including medical, business and economic movements, politics, and even human social life. For instance, a study conducted on a sample of twelve hundred and thirty-three inhabitants of Tehran utilized the TPB to explain variability in Disaster Preparedness Behavior (DPB) by Najafi M (2017). The goal of the research was to understand DPB based on the TPB. The research concluded that attitudes, subjective norms, and perceived behavioral control regarding DPB could predict intentions to engage in such behaviors that could assist in helping to develop interventions to DRR with the motivation derived through DPB. In addition to this, in the scholarly work of Vinnell, Milfont et al. (2023), they delve into the psychological aspects of disaster preparedness, specifically examining how the framing of natural events as either “natural hazards” or “natural disasters” influences people’s attitudes and behaviors. Their research aim was to develop and test a Theory of Planned Behavior approach to investigate why people prepare for natural hazards, which provides a comprehensive analysis of this phenomenon. The authors argue that the way these events are framed can significantly impact individuals’ intentions and actions towards preparedness. Likewise, a systematic review in the PLOS Currents Disasters highlighted about the frequent application of the TPB in disaster and emergency health preparedness. The review found that the TPB was commonly used particularly in relation to various hazards including influenza (H1N1 and H5N1), floods, and earthquakes (Ejeta LT 2015). Furthermore, in a recent investigation by Ng (2022), the extended Theory of Planned Behavior (TPB) was applied to analyze the impact of risk perception on disaster

preparedness behavior in the context of typhoons, a natural hazard. The results findings showed that behavior related to disaster preparedness was predicted by risk perception and intention. Risk perception had a notable effect on preparedness intention, with a partial mediation through the subjective norm. While risk perception significantly influenced attitudes and perceived behavioral control, these factors did not show a significant correlation with preparedness intention. This study underscores the pivotal role of risk perception and cognitive factors in shaping disaster preparedness for natural hazardous areas. In the realm of sustainable geohazards management, there has been a significant shift towards understanding public intention. One noteworthy study led by Xing, Que et al. (2023) delves into this by integrating unique variables into the traditional Theory of Planned Behavior (TPB) model. This innovative approach intertwines the intricacies of geohazards with public participation for sustainable geohazards management. The researchers expanded the TPB model by incorporating 'risk perception', 'disaster experience', and 'participatory cognition' as additional explanatory variables. This enriched model offers a more comprehensive understanding of public intention in the context of geohazards management. Bastam, Yazid et al. (2022) by means of using TPB introduces a validated instrument for assessing parental intentions towards active school transport. This instrument, tested in Palembang, Indonesia, incorporates psychological, social cognitive, perceived environmental, and habit constructs. The insights from this study can inform our understanding of parental behaviors related to school transportation in complex scenarios. The study in Hamadan, Iran by Ranaei, Hassani et al. (2021), investigated factors influencing safe traffic behavior among high school students. Data from 414 male students revealed a positive correlation between knowledge, attitudes, subjective norms, and perceived behavioral control with behavioral intention. These factors, along with perceived behavioral control and behavioral intention, significantly influenced traffic safety behavior. The findings suggest that the theory of planned behavior can be instrumental in predicting safe traffic behaviors among high school students. This theory could potentially be used to develop effective interventions aimed at promoting safe traffic behaviors and reducing road traffic injuries among young people.

The insights gained from these studies are instrumental for our research as well, as they guide our understanding of intentions of vulnerable students for non-resilient school transportation from disaster management aspect that can be modeled and influenced.

2.5.4 Independent Variables

2.5.4.1 Environmental Concern

The concept of environmental concern, as it currently stands, lacks a stable and universally accepted definition (Le Borgne, Sirieix et al. 2015). This term encompasses a broad spectrum of attitudes towards environmental issues, leading to varying interpretations and measures. One perspective defines it as an individual's recognition of the human-induced threats to the natural environment, coupled with a willingness to protect nature (Franzen and Vogl 2013). Another viewpoint describes it as a comprehensive concept that spans from a specific attitude towards environmentally relevant behavior to a broader value orientation (Fransson and GÄRling 1999). A complementary approach to defining environmental concern is based on the dimensions of an attitude: affective and cognitive (Franzen and Vogl 2013). From this perspective, an individual with high environmental concern is characterized by a strong understanding of, or belief in, environmental challenges (cognitive dimension), a deep sense of concern about these challenges (affective dimension), and a strong intention to act in ways that protect the environment (cognitive dimension). This multidimensional approach provides a more nuanced understanding of environmental concern, capturing the complexity of individuals' attitudes towards the environment. Studies have explored the individual determinants of environmental concern, such as gender, age, education, and income. However, the results of these studies have been varied and inconclusive (Marquart-Pyatt 2012).

2.5.4.2 Risk Taking Propensity

The concept of risk perception is defined as an individual's ability to assess the level of risk associated with a specific behavior or activity (Ajzen 2002). Risk-taking, in decision theory, has traditionally been understood as the preference for options with higher outcome variance over those with lower outcome variance (Mishra 2014).

However, within the realm of personality literature, definitions of risk propensity are less abundant and often vague. For instance, definitions such as "a general tendency to take risks" (Sitkin and Pablo 1992) are not only repetitive but also mix the predictor with the criterion. Accordingly different perspectives have also been offered on the likelihood of risk-taking. March and Shapira (1992) proposed that it is determined by one's differential focus on aspiration versus survival. Risk attitude suggested by Lopes (1987) as a differential importance on hope vis-a-vis fear. The same arguments have been presented about regulatory importance and risk-taking (Hamstra, Bolderdijk et al. 2011). Risk aversion is considered a fundamental trait inherent in human behavior (Highhouse, Wang et al. 2022). As put by Lopes ((1984);(1987)) risk seekers pay more attention to the best outcomes in a delivery, while risk-averse individuals focus on security. In this view, risk seekers are driven by potential, whereas risk-averse individuals are driven by a desire for security.

2.6 Disaster Risk Science; an evolution of Disaster Risk Reduction (DRR) and Sustainable Development

In 2019, the world observed the 30th anniversary of the United Nations' (UN) global disaster risk reduction (DRR) initiatives. While the timeframe of May 23 to May 27, 1994, marked the occurrence of the First World Conference on Disaster Reduction in Yokohama, Japan. According to, "*Yokohama Strategy and Plan of Action for a Safer World"* (IDNDR 1994) the output of this conference indicated that a safer world and the realization of sustainable development depend on prioritizing disaster prevention, preparedness, mitigation, and relief measures which relies on a proactive approach rather than a reactive one. In the month of November 2000, the 54th United Nations General Assembly made the decision to implement the *"International Strategy for Disaster Reduction (ISDR)*" and to establish a Secretariat for the purpose of coordination. From January 18 to 22, 2005, the Second World Conference on Disaster Reduction was conducted in the city Kobe, Japan. At this conference "*The Hyogo Framework for Action 2005–2015"* was adopted (UNISDR 2005), underlining the significance of enhancing the resilience of nations and communities to disasters. The Third UN World Conference

on Disaster Risk Reduction took place from March 14 to 18, 2015, in Sendai, Japan. The official result of this conference, namely the "*Sendai Framework for Disaster Risk Reduction 2015–2030*" (UNISDR 2015), declared four priorities exclusively: understand disaster risk, strengthen disaster risk governance to manage disaster risk, invest in disaster risk reduction for resilience, and enhance disaster preparedness for effective response and to Build Back Better in recovery, rehabilitation, and reconstruction. As a successor, the Sendai Framework also urged for increased international cooperation in forming a global partnership for Disaster Risk Reduction (DRR) to address the impacts of climate change and work towards achieving the Sustainable Development Goals lasting until 2030, along with the other 2030 Agenda agreements which are The Paris Agreement on Climate Change, The Addis Ababa Action Agenda on Financing for Development, the New Urban Agenda, and ultimately the Sustainable Development Goals (SDGs) (UNDRR-SFDRR 2015-2030). To date, it's been 30 years of collective efforts of all countries, sectors, and stakeholders, all dedicated to the pursuit of scientific strategies, effective methods, advanced technologies, and robust measures to advocate for Disaster Risk Reduction (DRR).

Figure 4.2: Integrating global frameworks for sustainable, risk-informed development, Source: (©NadinandOpitz-Stapleton 2019)

2.7 Recent Development in Disaster Risk Reduction (DRR); a Global Perspective

As per the latest development in DRR, a Global Assessment Report (GAR) on Disaster Risk Reduction (DRR) 2023 (UNDRR-GAR 2023) has been presented by the United Nations Office for Disaster Risk Reduction, titled "*Measuring Resilience for the*

Sustainable Development Goals". The report presents a noteworthy perspective on the evolving landscape of disaster risk and resilience. It emphasizes the ongoing trend of growing interconnectedness among people and human systems, which simultaneously intensifies the susceptibility to complex and cascading crises. Following the adoption of the Sendai Framework for Disaster Risk Reduction (SFDRR) (2015-2030) and the Sustainable Development Goals (SDGs) in 2015 (United-Nations 2016), it became clear to world, that developing countries face a continuous struggle. They often get caught in a cycle of disaster recovery, making it difficult to achieve their goals of sustainable development. The annual report consistently highlights this challenge. However, it also enlightened that incorporating resilience-thinking can advance the necessary paradigm shift to benefit people, the planet, prosperity, and future generations because when we look at resilience-building holistically, we clearly see that crucial resilience issues are the ones that actually limiting all of the sustainable development evidently.

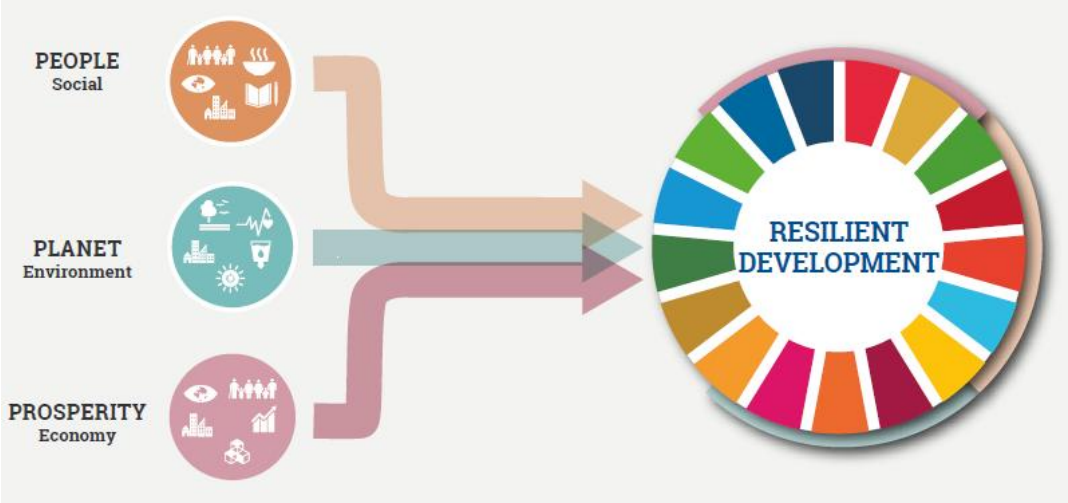


Figure 2.5: Resilient development – people, planet and prosperity. (UNDRR-GAR 2023)

The literature review provides a comprehensive exploration of the urban school transportation ecosystem, and disaster management, with a particular focus on the Theory of Planned Behavior (TPB). It has highlighted the significant role of individual attitudes, subjective norms, and perceived behavioral control in influencing transportation choices and disaster preparedness behaviors. The review has also

underscored the importance of environmental concern and risk-taking propensity as key variables in these domains. A crucial aspect of this research is the mainstreaming of Disaster Risk Reduction (DRR) in Karachi's school transportation system. The aim is to foster resilience by focusing on DRR, which is integral to achieving the Sustainable Development Goals (SDGs). This approach recognizes that school transportation is not merely an administrative function but a complex system requiring strategic attention for risk mitigation.

The literature review has established the relevance and applicability of the TPB in these fields. It sets the stage for the proposed research, which aims to further explore these areas and contribute to the existing body of knowledge. The research focus on understanding the intentions of vulnerable students dealing with exposure to potential risks and hazards in school transportation ecosystem from a disaster management perspective, thereby addressing a significant gap in the current literature. This research is pioneering in its regional focus, being the first of its kind to be conducted in the country. It aims to provide valuable insights into the urban and school transportation ecosystem, which is not merely an administrative function but a complex system requiring strategic attention for risk mitigation. In conclusion, the literature review has not only provided valuable insights into the current state of research in these areas but also identified potential avenues for future exploration. It has laid a solid foundation for the proposed research, underscoring its significance and potential impact. This research is expected to make a significant contribution to the field, particularly in the context of the region it focuses on.

Chapter 3

3. Research Methodology

This chapter outlines the comprehensive methodology followed in conducting this research study. The research is based on fostering resilience under the umbrella of DRR by addressing the interconnectedness of school transportation and the urban ecosystem and its comprehensive impact on students' overall well-being and its model validation which follow the research flow chart shown in figure 3.1.

A correlational research design has been applied to examine the associations between independent variables mediating with dependent variables of the theoretical proposed model which appears as the extended theoretical framework of the theory of planned behavior. This design enabled the exploration of relationships without any manipulation of the variables. It has been considered suitable for investigating the complex dynamics within the complex landscape of the study.

Given the nature of the research, the existing methodological flow chart is segmented into three stages: Pre-analysis, Technical analysis, and Post analysis. The specifics of these stages are illustrated in the research process diagram depicted in figure 3.2. Likewise, this section presents a detailed explanation of the boundary, target sample, process of survey/data extraction, implementation of the survey, data interpretation using Microsoft Excel, and analysis of the gathered data utilizing the Partial Least Square Structural Equation Modelling (PLS-SEM) software.

The data used in this research is primary data which were collected in Karachi Metropolitan Area (districts) in 2023. A comprehensive data was collected for five consecutive months at the school university level. The independent variables (environmental concerns, involvement in transportation, and risk-taking propensity), mediating variables (attitude, subjective norms, and perceived behavioral control), dependent variable (behavioral intention) are used in the current study from published work (Paul, Modi et al. 2016), (Irtema, Ismail et al. 2018), (Meertens 2008). These variables are primary because they form the basis of theoretical proposed model and are

central to research objectives of the study. These variables will guide the design of questionnaire and the analysis of our collected data.

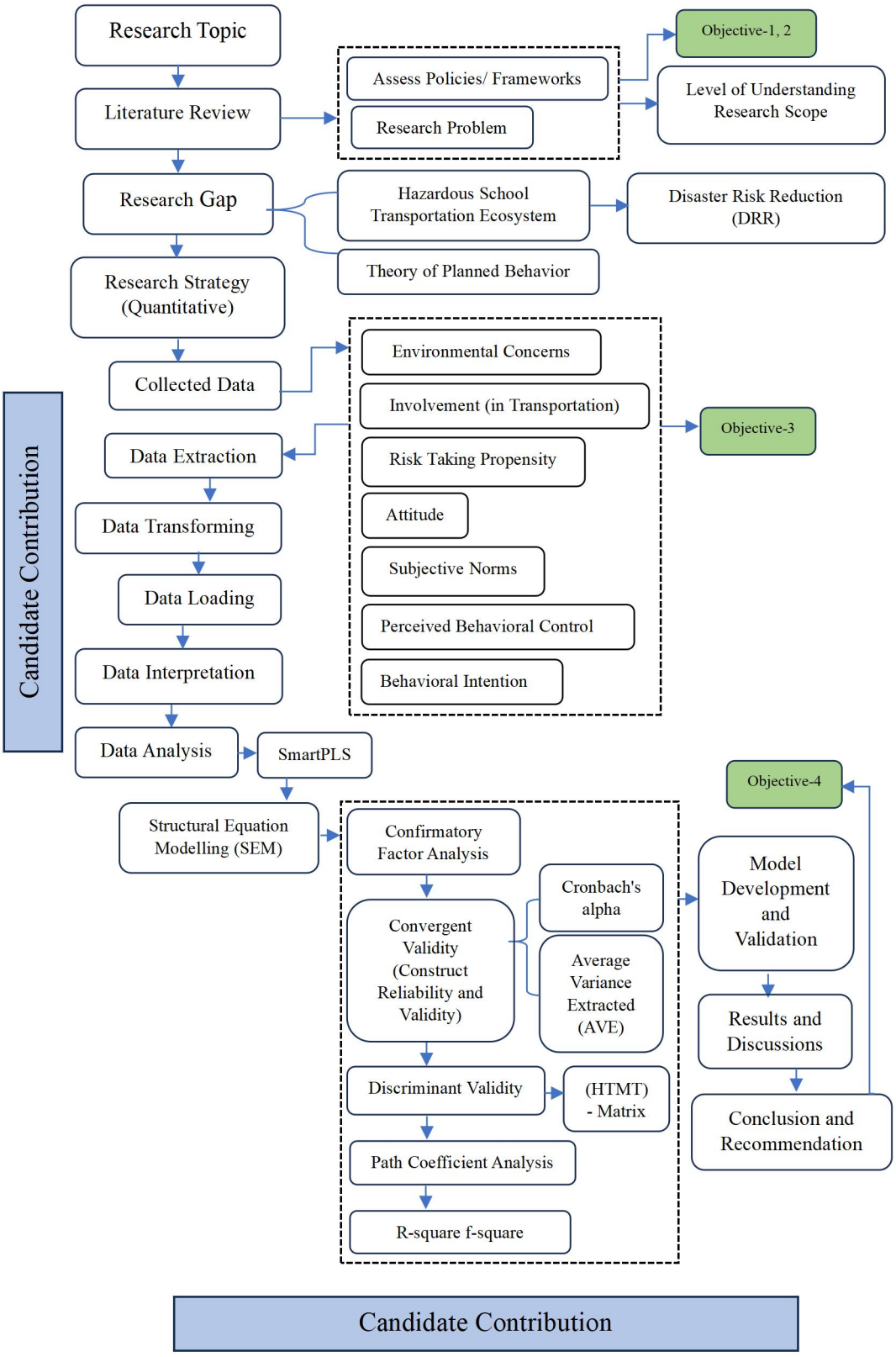


Figure 3.1: Research Methodology Flow Chart

The initial phase, known as the pre-analysis phase, covers the research topic, review of related literature, identification of the problem, formulation of research aims and objectives, development of the research methodology, and design of data collection. Afterwards the technical analysis phase discusses the analysis of the collected data and modeling. SmartPLS-4 was used to create variance based structural equation modelling (SEM) using the partial least square (PLS) path modeling technique for data analysis. The SEM was employed due to mediation to examine the interaction of variables and confirm the validity of the model.

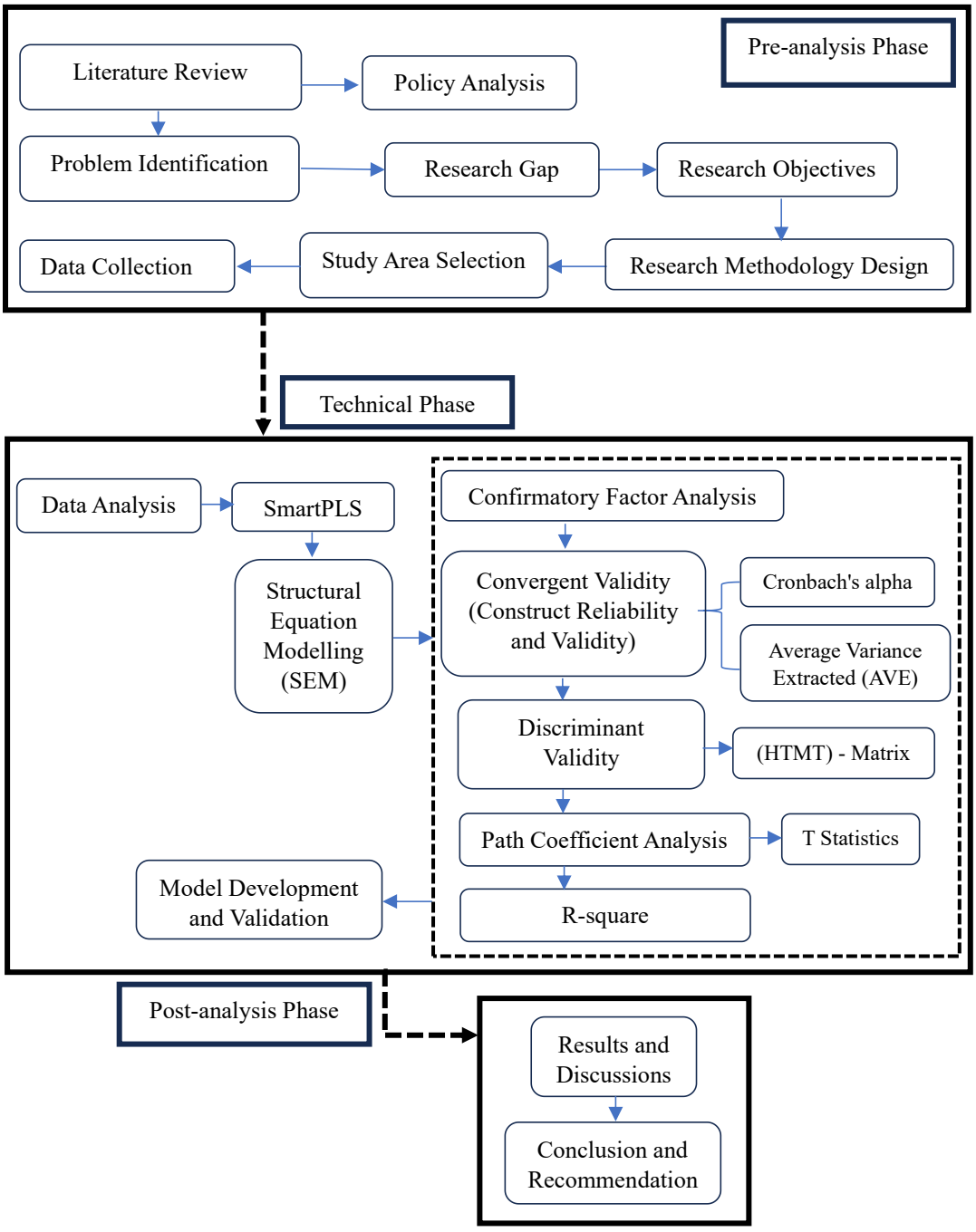


Figure 3.2: Research Process Diagram

3.1 Study Variables

This research focuses on the absence of a safe school transportation system. The study considers this issue as a man-made hazard that poses risks to education, health, and life. Due to the interdisciplinary nature of the problem, as already discussed in chapter 2 and according to the recent literature, this study contains psychosocial variables that represent various aspects of human cognition, behavior, and social interactions. The study identifies environmental concerns, involvement in transportation, and risk-taking propensity as independent variables. Whereas mediating variables like attitude, subjective norms, perceived behavior control, and a dependent variable, behavioral intention are of the theory of planned behavior. The details of all variables are shown in table 3.1. The research adopts a deductive approach, thereby using an established theory (TPB) to conduct the study.

Table 3.1: Study variables and their factors

Independent Variables	**Mediating Variables** **TPB**	**Dependent Variables** **TPB**
Environmental concerns natural environmental factors and unnatural environmental factors	**Attitude** positive, favorable, good choice, beneficial or safe preferences about transport	**Behavioral intention** about daily school transport usage, probability of taking school transport for all travels, high intention of taking school transport
Involvement (in transportation) daily transit, lifestyle, eco-friendliness, travel time pressure, joy of transport, information about transport	**Subjective Norms** importance, preferences, desire, use, choices of recommendations as per safety and security of transport	
Risk-taking propensity preferences about unexpected situations, to avoid risks, risking over health, prioritizing risk	**Perceived Behavior Control** control perception of using transport	

3.2 Survey Strategy

This research is a quantitative research based on the questionnaire survey. The questionnaire survey is developed to systematically collect the primary data by systematically asking respondents about their environmental concerns, involvement in transportation, propensity of taking risk, attitude towards school transport in subjective norms, and perceived behavior control to behavioral intention. The questionnaire survey primarily developed by transforming according to study from published study for primary data collection depending on the respondents' data needed to collect.

The questionnaire survey was conducted face-to-face (physically) with the individuals. We collected data with a focus on the sampling design. Data were collected using the online platform Google form between June 2023 to October 2023. A URL link to the survey questionnaire and a QR-code of the same was created to present to the prospective respondents. As data collection involved a personal outreach strategy, it was conducted outside schools from parents and interaction with university students in university premises. Data collected from respondents (parents) on weekdays nearly school-off timings, where building an understanding with respondents (parents) was pivotal and also complex before providing the URL link, but mostly a survey-QR code that linked to same online Google Form questionnaire was used, enabling timely responses as they were voluntarily participating. Data collected from respondents (university students) through recognized teachers and professors after submitting covering letter was also found critical, to facilitate the interaction within class sessions on university premises to provide university students awareness of the research background along survey link among the respondents (university students).

3.3 Target Population

Our study cast a wide net, encompassing school students and university students who live in the metropolitan landscape of Karachi city. The study area was selected based on the riskiest transportation usage within rapid urbanization, and majority students facing transportation challenges daily around the clock. The survey was prepared for adults (university students above 15 years old) and dependent children (7 -

15 years old). Given the restrictions on interacting directly with school students, we elected to engage with their parents, who in fact make decisions about their children's commute. On the other hand, university students, who are typically not minors and have more autonomy, make their own commuting decisions. This comprehensive approach allowed us to gather diverse perspectives on commuting safety in the school transportation ecosystem.

3.4 Measurement Scale and Instrument of Data Collection

This study utilizes a survey-based investigation. The primary instrument for data collection was a methodically designed questionnaire from established questionnaires. The questionnaire was designed based on the constructs of the Theory of Planned Behavior; attitude, subjective norms, perceived behavioral control, behavior intention along with independent variables such as environmental concerns, involvement (in transportation) and risk-taking propensity. The questions were designed to be clear and concise, to accurately measuring these constructs. The questionnaire consisted of Likert scale questions, ranging from 1 (strongly disagree) to 5 (strongly agree). The Likert scale is a commonly utilized rating system that asks respondents to express their level of agreement or disagreement with a series of statements related to the subject of the questionnaire. As per common practice, a typical five-point Likert Scale includes scores from 1 to 5. The midpoint, 3, signifies a neutral stance, while 1 and 5 represent the polar ends: strong disagreement and strong agreement, respectively. The scores 2 and 4 correspond to disagreement and agreement (Doyle, Brady et al. 2009). This structured approach acquired to facilitate a comprehensive analysis of the quantitative data.

Table 3.2: Five-Point Likert Scale

Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1	2	3	4	5

Table 3.3: Instrument For Data Collection

	Attitude (Paul, Modi et al. 2016)					

S.no		**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1.	My attitude towards transport is positive	1	2	3	4	5
2.	I find using the transport favorable	1	2	3	4	5
3.	I find using the transport a good choice	1	2	3	4	5
4.	I find using the transport quite beneficial	1	2	3	4	5
5.	I find the transport as a safe option	1	2	3	4	5
	Subjective Norms (Paul, Modi et al. 2016)					
1.	Most people who are important to me would find it safe if I use the transport	1	2	3	4	5
2.	Most people who are important to me would want me to use the transport	1	2	3	4	5
3.	The people who are important to me would find it desirable that I use the transport	1	2	3	4	5
4.	My colleagues would support my decision to use the transport	1	2	3	4	5
5.	Most people in my situation use the transport	1	2	3	4	5
6.	The people who are important to me would use the transport if they were in my place	1	2	3	4	5

	Perceived Behavioral Control (Paul, Modi et al. 2016)					
1.	For me, using the transport is easy	1	2	3	4	5
2.	Using the transport is not complex	1	2	3	4	5
3.	For me, using the transport is very straightforward	1	2	3	4	5
4.	If I wanted to use the transport, I'd be comfortable to do so	1	2	3	4	5
	Environmental Concerns (Paul, Modi et al. 2016)					
1.	I'm worried about environmental impact, caused by motor vehicles use	1	2	3	4	5
2.	I would be willing to use my vehicle less if that helped the environment without compromising safety	1	2	3	4	5
3.	Considerable political change is necessary to increase the environmental stability of the traffic and transportation sector	1	2	3	4	5
4.	Considerable social change is necessary to increase the environmental stability of the traffic and resilient transportation	1	2	3	4	5
5.	Disaster risk reduction laws/ policy should	1	2	3	4	5

	be implemented more strictly					
6.	If more students would use the current transportation, the environment would profit	1	2	3	4	5
	Involvement (in Transportation) (Irtema, Ismail et al. 2018)					
1.	The school transit is significant to my everyday life	1	2	3	4	5
2.	I feel that taking school transit has consistency with lifestyle	1	2	3	4	5
3.	I like people to know that I take eco-friendly/school transit	1	2	3	4	5
4.	Despite being under pressure concerning time, I would always prefer to take school transport	1	2	3	4	5
5.	I enjoy taking school transport	1	2	3	4	5
6.	I am always attentive to the information about school transport	1	2	3	4	5
	Risk Taking Propensity (Meertens 2008)					
1.	Safety is first for me	1	2	3	4	5
2.	I do not take risks with my health	1	2	3	4	5
3.	I prefer to avoid risks	1	2	3	4	5
4.	I really dislike not knowing what is going	1	2	3	4	5

	to happen					
	Behavioral Intentions (Paul, Modi et al. 2016)					
1.	I have a high intention of taking school transport	1	2	3	4	5
2.	High probability of taking school transport for all my travels	1	2	3	4	5
3.	I want to take the school transport daily	1	2	3	4	5

3.5 Sample Size and Strategy

Convenience sampling technique was used due to its practicality. This non-probability sampling technique allows for the selection of participants based on their accessibility and ease of contact (Stratton and Medicine 2021). The ideal sample size for convenience sampling is 385 due to unlimited population. However, we aimed for a larger sample of 1,000 respondents based on the accessibility and availability that too from three most populated districts of Karachi city as much as possible. In this case, we aimed to reach approximately 10% of the schools from total institutions of groups that denotes different levels of education as a starting point in each district.

The first area (**district central**):

Group 1 (Secondary schools): 10% of 1044 schools, resulting in a target of 104 schools.
Group 2 (Higher Secondary schools): 10% of 11 schools, resulting in a target of 1 school.
Group 3 (O & A Level schools): 10% of 46 schools, resulting in a target of 5 schools.
Total Institutions =1101 (schools) Total enrolment =280,922 (students)
To reach among =110.

The second area (**district east**):

Group 1 (Secondary schools): 10% of 937 schools, resulting in a target of 94 schools. Group 2 (Higher Secondary schools): 10% of 21 schools, resulting in a target of 2 schools. Group 3 (O & A Level schools): 10% of 151 schools, resulting in a target of 15 schools.

Total Institutions =1109 (schools) Total enrolment =286,835 (students)

To reach among =111.

The third area (**district south**):

Group 1 (Secondary schools): 10% of 571 schools, resulting in a target of 57 schools. Group 2 (Higher Secondary schools): 10% of 16 schools, resulting in a target of 2 schools. Group 3 (O & A Level schools): 10% of 92 schools, resulting in a target of 9 schools.

Total Institutions =679 (schools) Total enrolment =173,417 (students)

To reach among =68

Also, we only focused private schools in our convenience sampling, aiming to interact with parents outside these schools. The list of these registered private institutions in the Karachi region was obtained from the School Education & Literacy Department, Government of Sindh (GoS). As for universities, our aim was to obtain a representative sample from the approximately 29 universities in the city, focusing on selected districts (Higher Education Commission).

SCHOOL EDUCATION & LITERACY DEPARTMENT GOVERNMENT OF SINDH

DIRECTORATE OF INSPECTION/ REGISTRATION OF PRIVATE INSTITUTIONS, SINDH, KARACHI

LIST OF REGISTERED PRIVATE INSTITUTIONS OF KARACHI REGION.

Sr. No.	REGION / DIVISION	District	Primary & Elementary Schools	Teacher	Enrollment	Secondary / High Schools	Teacher	Enrollment	Higher Secondary Schools	Teacher	Enrollment	O & A Level Schools	Teacher	Enrollment	Total Instittions	Total Teachers	Total Enrollment
1	KARACHI	District Central	236	2031	49368	1044	10932	270111	11	63	1580	46	376	9231	1337	13402	330290
		District East	275	2288	55624	937	10298	254186	21	170	4217	151	1156	28432	1384	13912	342459
		District Korangi	136	1111	27001	783	7927	195930	12	77	1932	7	68	1662	938	9183	226525
		District Malir	251	2022	49166	621	7042	174054	24	91	2282	13	172	4246	909	9327	229748
		District South	156	1658	40300	571	6186	152892	16	119	2985	92	712	17540	835	8675	213717
		District West	143	1517	36875	974	8340	206155	29	112	2810	5	31	739	1151	10000	246579
		TOTAL:	1197	10627	258334	4930	50725	1253328	113	632	15806	314	2515	61850	6554	64499	1589318

Figure 3.3: Population history

3.5.1 Unit of Analysis

It's important to understand that the primary objective of a transport system is to facilitate commuter's access. Recognizing that a transportation system encompasses various modes, including walking, active transport, and bus transit, this study focuses on the safe school transportation system that addresses strategies to mitigate potential hazards and risks which severely impacts the physical, psychological and social well-being of travelers. School-going students (represented by parents) studying in classes above 5, and university students are considered. Parents are included as they are the decision-makers for their children's transportation because the aim is to gain comprehensive insights into the transportation ecosystems and their adverse effects on these specific groups.

3.6 Data Source/ Design

The origin of data in a research study is referred to as the data source. In this particular study, primary data is gathered through a survey that was accomplished through a primary source (the researcher is the first person to obtain the data). Explanatory research is carried out for this study, in which the quantitative data are collected and analyzed. The quantitative method for data collection process was designed to be a blend of traditional and modern techniques. Respondents were engaged in a face-to-face interaction, during which they were asked to scan a QR code with their phones. This QR code leads them directly to a digital survey tool, Google Forms. This method of data collection effectively combines the personal touch of traditional face-to-face interactions with the efficiency and convenience of modern digital surveys. The collection of data is a very daunting task thus plays a very crucial role in statistical analysis. Data consists of factual information, numerical figures, and a collection of values representing quantitative or qualitative variables, from which deductions and conclusions can be derived (Ajayi 2017).

3.7 Data Extraction

The process of retrieving data from the chosen source is known as data extraction. In this study, once the respondents have completed the survey, the data is extracted by downloading the results directly from Google Forms into an Excel sheet. This method of data extraction is both direct and digital, ensuring that the data is readily available for subsequent analysis.

3.8 Interpretation of Data

If data is appropriately interpreted, favorable outcomes are attainable, and conversely. In this study, the data acquired through a blended quantitative method designed to combine traditional and modern techniques, involves engaging respondents in face-to-face interactions with the efficiency and convenience of modern digital surveys as mentioned earlier. The subsequent data extraction and analysis processes encompass the representation and interpretation of collected data within Microsoft Excel Sheets for assessment and refinement. Eventually, the data is already transformed into a digital format, thus simply imported into SmartPLS for SEM to estimate complex cause effect relationships in path models with latent variables using a sequence of regressions

in terms of weight vectors. The analytical approach involves specifying the research model, coding indicators as reflective or formative, and importing the dataset into SmartPLS. The measurement model is assessed for reliability and validity, and the structural model is defined to evaluate hypotheses about directional relationships. Bootstrapping analysis is performed to estimate the significance of path coefficients, and the strength of relationships is evaluated through coefficient and R^2 analysis. The overall model fit is assessed using criteria such as the goodness-of-fit (GoF) index. Results are interpreted in the context of research questions and hypotheses, and findings are documented for inclusion in the research report.

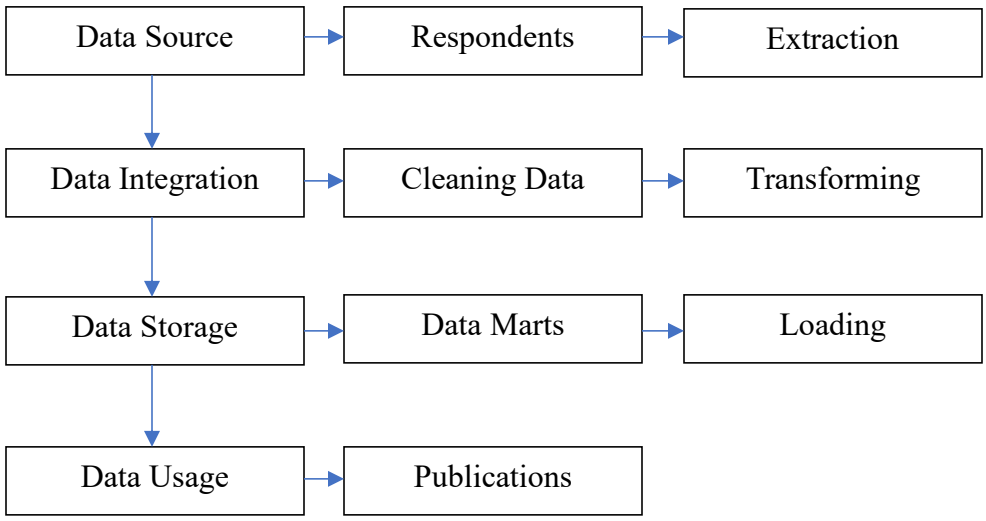


Figure 3.6: Data Preparation Flow Chart

3.9 Mediation Approach

The mediation method is a widely accepted approach that holds significant importance in the domains of travel behavior and psychological studies (Figueredo, Garcia et al. (2013); MacKinnon and Fairchild (2009)). It involves the introduction of a new variable that acts as a conduit between the independent and dependent variables. Mediation typically comes into play when the independent variable falls short in adequately explaining the dependent variable. As per certain studies, mediation serves to elucidate the process or mechanism by which one variable impact another(MacKinnon

and Fairchild 2009). This leads to the conclusion that exogenous variables do not directly, or have minimal direct, influence on the endogenous variables. The use of a mediation variable allows the exogenous variable to demonstrate its influence on the endogenous variables (Nitzl, Roldan et al. 2016).

The mediation approach necessitates three distinct steps:

a. A significant relationship must exist between the dependent and independent variables, known as path "c".
b. A significant relationship must be established between the independent variables and the mediator, referred to as path "a".
c. A significant relationship must be present between the mediator and the dependent variables, termed as path "b"

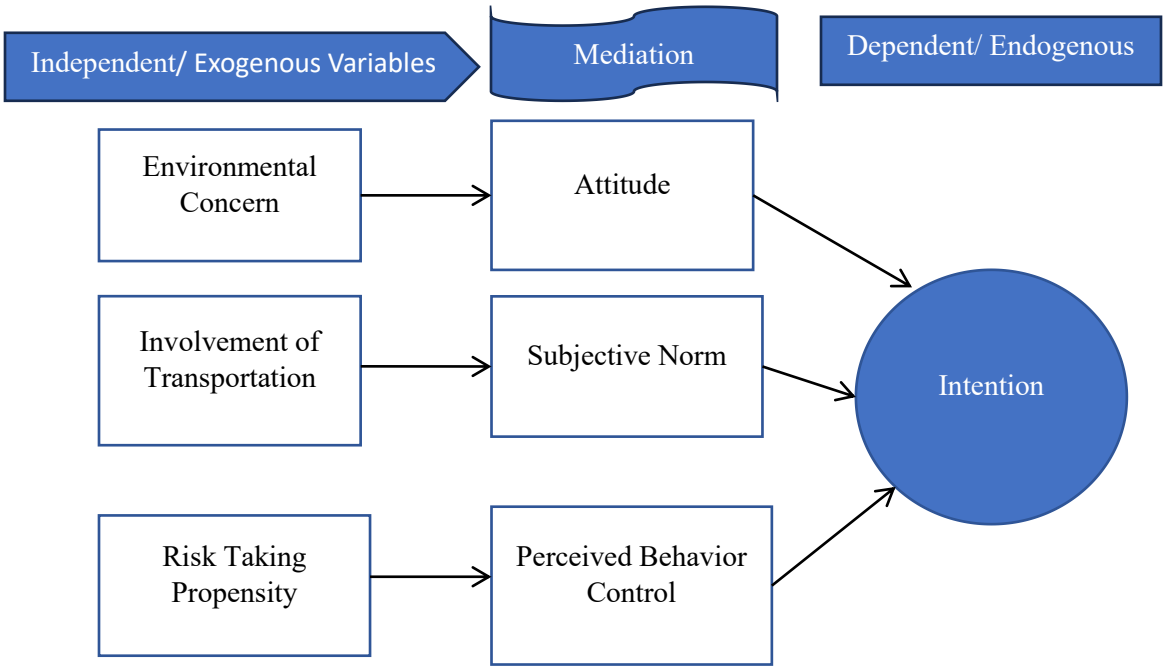


Figure 3.7: Theoretical Proposed Model

3.10 Hypotheses Development

The following hypotheses are proposed to address the objective and aim of the study and serve as the guiding propositions for this research, underscoring the connection between transportation systems, their inherent risks, and the impact on educational access. This approach allows us to examine the complex dynamics for the safe school transportation ecosystem in Karachi, Pakistan, through a comprehensive lens.

H1: The level of environmental concern among parents and university students has a positive impact on their attitude towards safe school transportation.

H2: The level of environmental concern among parents and university students positively influences their subjective norms related to safe school transportation.

H3: The level of environmental concern among parents and university students positively influences their perceived behavioral control over safe school transportation.

H4: The involvement of parents and university students in transportation has a positive impact on their attitude towards safe school transportation.

H5: The involvement of parents and university students in transportation has a positive impact on their subjective norms related to safe school transportation.

H6: The involvement of parents and university students in transportation has a positive impact on their perceived behavioral control over safe school transportation.

H7: The risk-taking propensity of parents and university students has a positive impact on their attitude towards safe school transportation.

H8: The risk-taking propensity of parents and university students has a positive impact on their subjective norms related to safe school transportation.

H9: The risk-taking propensity of parents and university students has a positive impact on their perceived behavioral control over safe school transportation.

H10: The attitude of parents and university students towards safe school transportation has a positive impact on their intention to use it.

H11: The subjective norms of parents and university students related to safe school transportation have a positive impact on their intention to use it.

H12: The perceived behavioral control of parents and university students over safe school transportation has a positive impact on their intention to use it.

A theoretical framework is an element of the conceptual framework that situates the relationships under investigation within the process of developing or testing formal theories (Hussein 2023), in order to achieve the objective of developing a theoretical framework for the study which is to establish a solid scholarly basis for data interpretation. It acts as a consolidation of previously validated and published theories, concepts, and hypotheses (Grant and Osanloo 2014). In this study, the deductive approach applied to derive hypotheses from the theoretical proposed model that consist 7 main variables (three exogenous variables integrated with constructs of TPB that mediating with an endogenous variable) based on the extensive review of the literature (as discussed earlier), which then have tested and validated in the context of Karachi school transport ecosystem using the quantitative methods for statistical analysis by SEM technique explained in next chapter. The explanatory research approach applied to interpret the findings and provide explanations for the observed relationships.

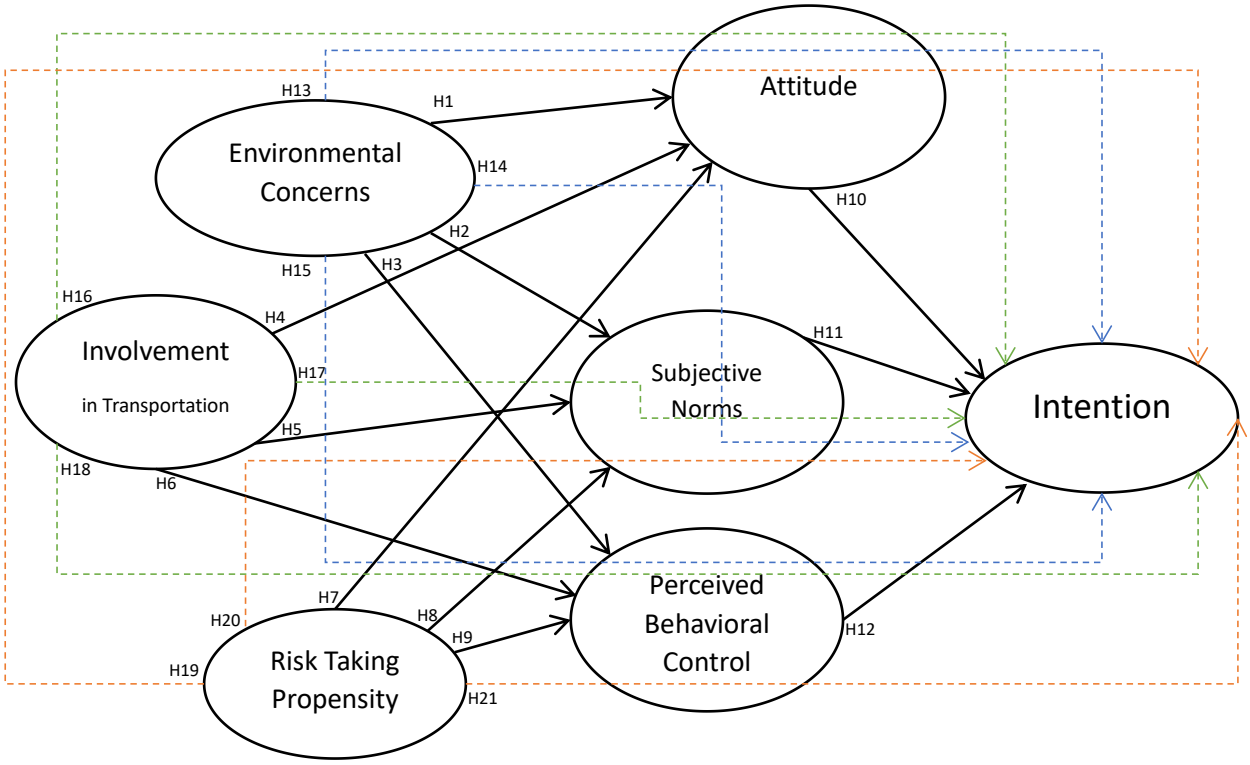


Figure 3.8 Theoretical proposed model

3.12 Analytical Method

This section describes the array of analytical strategies applied in this study to examine the collected data and fulfill the intended objectives. A theoretical model is proposed, demonstrating the relationship between the independent variables - environmental concerns, involvement in transportation, and risk-taking propensity. These are integrated with the constructs of the Theory of Planned Behavior (TPB) - attitude, subjective norms, and perceived behavioral control, acting as mediating latent variables over the dependent latent variable (behavioral intention). The proposed model illustrates the correlation between external latent factors that, through intermediary latent variables, shape perceptions about using safe school transport. The influence between these variables is quantified through statistical analysis. Quantitative data is gathered through a digital questionnaire survey conducted via a personal face-to-face approach and is analyzed using the SmartPLS-SEM software. The collected survey data has been proposed to undergo for quantitative analysis employing appropriate statistical methods to identify patterns and trends. Given the mediation present in the theoretical proposed model, the Structural Equation Modeling (SEM) technique is selected. SEM employed to validate the questionnaire. Rigorous examinations of face validity, construct validity, convergent validity, and discriminant validity are undertaken to enhance the robustness of the model framework. Additionally, Table 3.4 provides a detailed explanation of the analytical methods employed to achieve the necessary objectives.

Table 3.4: Data collection and analysis techniques to achieve the research objectives

S.no	Objectives	Data Collection	Data Analysis
1.	(objective 1) Analyze national and international policies related to school transportation to identify problem	Policies collected from official government websites and other reliable sources	Internet research-based analysis of collected policies
2.	(objective 3) Investigate the relationship between	Theoretical model	Developed a TPB model with external

	various factors and people's perceptions related to safe school transportation		variables
3.	(objective 3 continue) Conduct statistical analysis to validate the model	Primary data (through a digital questionnaire survey via a personal ftf approach)	SEM software by SmartPLS-, Model Validation

3.13 Ethical Considerations

This study adheres to ethical guidelines for research. Ethical considerations stay ensured that participants' rights and freedom are respected as their voluntary participation status, the research's academic nature, and the absence of financial incentives (Call, Eckstrand et al. 2023). Informed consent stayed obtained, with the assurance of anonymity and confidentiality of the data. Participants stayed assured of their right to withdraw without repercussions. Ethical principles continued thoroughly adhered to emphasizing the research's ethical conduct and commitment to producing plagiarism-free results.

3.14 Time Frame of the Research

The research was conducted within the timeframe required for completing the Master of Science academic degree. Multi-dimensional used five months based on the primary data through questionnaire survey for complex population.

Chapter 4

4. Data Analysis and Results

In this chapter, we analyze the collected data. The collected data based on methodology as discussed earlier. We begin by presenting descriptive statistics of survey participants, while further explaining of the measurement and structural models employing Partial Least Square Structural Equation Modelling (PLS-SEM). Moreover, the chapter delves into the analysis of the independent and mediating effect of the constructs from theory of planed behavior along environmental concerns, involvement (of transportation) and risk-taking propensity constructs.

4.1 Descriptive Statistics

As described earlier, parents of school students and students of universities in Karachi were selected as respondents. Table 4.1 shows the descriptive statistics of the 993 respondents in our sample. It shows that our sample is from two categories: parents of school students (secondary, high secondary, O/A level) and university (bachelors & masters). Due to the restrictions on interacting directly with school students, we engaged with their parents, who often make decisions about their children's commute. For our university student respondent, the number of universities we reached were 16. Most of the respondents are from the university level with 59.2% (includes both male and female students with the ratio of 36.2% and 23.1% respectively), followed by 40.8% responses from the parents of school students. This also covered the gender distribution of the respondents. Figure 4.1 shows the statistics of the 993 respondents in our sample.

Table 4.1: Descriptive Statistics

S.no	Educational Level	Education Category	Total.no reached
1.	Schools (secondary, high secondary, O/A level)	Above class 5	289
2.	Universities	Bachelors, Masters	16

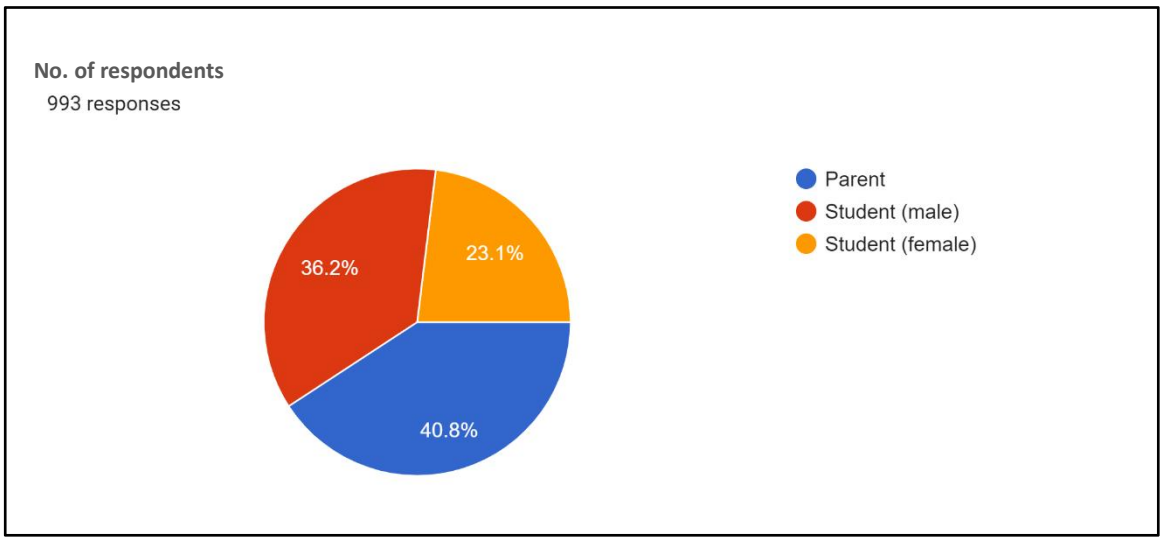


Figure 4.1: Respondents Description

Survey research often gets into the struggle with the task of choosing a suitable statistical model for analysis. Two prominent multivariate data analysis methods, namely Partial Least Squares based Structural Equation Modelling (PLS-SEM) and Covariance-Based Structural Equation Modelling (CB-SEM), are frequently employed by researchers and scholars under various fields (Bagozzi and Yi (1988); Carrus, Passafaro et al. (2008); Götz, Liehr-Gobbers et al. (2010); Lowry and Gaskin (2014)). Multivariate analysis is a method that handles multiple variables. The estimates from this regression illustrate the connection between a single dependent variable and one or more independent variables.

4.2 PLS-Structural Equation Modelling Assessment

PLS-SEM technique grounded in the principal component concept, ideal for theory building and uses the partial least squares estimator. It supports analyze both direct and indirect correlations between independent and dependent variables that serves two key purposes: confirming the measurement model through Confirmatory Factor Analysis (CFA) and through path analysis establishing the structural model to test research hypotheses (Gallagher and Brown 2013). Whereas, CB-SEM, due to concept of factor analysis suitable for theory testing for employing maximum likelihood estimation.

PLS-SEM, a variance-based SEM, is widely recognized in various fields of research, including transportation management, where it aids in understanding and predicting complex phenomena of mobility choice, impacts, intentions and perceptions (Lucarelli, Mazzoli et al. (2020); Memon, Ramayah et al. (2021); Javid, Abdullah et al. (2022); Li and Zhang (2023) in order to study the influence of exogenous and mediation variables on the endogenous variables and to validate the study model, because of the intricate interdependencies among multiple variables by allowing for the simultaneous examination of relationships, integrating latent constructs for a more comprehensive analysis in research. It qualifies construct validity and enable differentiation between reflective and formative measurement models. As suggested by Urbach, Ahlemann et al. (2010) PLS-SEM is a suitable substitute for CB-SEM. PLS-SEM when dealing with a theoretical model that shows complexity, includes multidimensional variables, presents a novel proposition, and encompasses both reflective and formative constructs. It is composed of two primary models: the measurement model and the structural model which depicts path coefficients and evaluates both direct and indirect relationships among latent constructs (Hair, Hult et al. 2021). In this situation, for our study we have opted PLS-SEM for the following reasons:

1) Its suitability for theory construction studies (Vinzi, Trinchera et al. (2010); Hair, Ringle et al. (2011); Ismael and Duleba (2021).

2) Its appropriateness for analyzing complex cause-effect relationship models (Bojórquez-Tapia, Ezcurra et al. (1998); Henseler, Ringle et al. (2009); Lowry and Gaskin (2014); Montalvo-Falcón, Sánchez-García et al. (2023)).

3) Its non-parametric nature, which imposes less limitations, particularly on data distribution and sample size (Vinzi, Trinchera et al. 2010).

To test our hypothesis, we used the smart-PLS 4 software (as per Ringle, Wende et al. (2022)). We utilized the PLS-SEM approach and assessed both the measurement model (alternatively known as the outer model) and the structural model (alternatively known as the inner model). A more detail of our approach can be found in Figure 4.2.

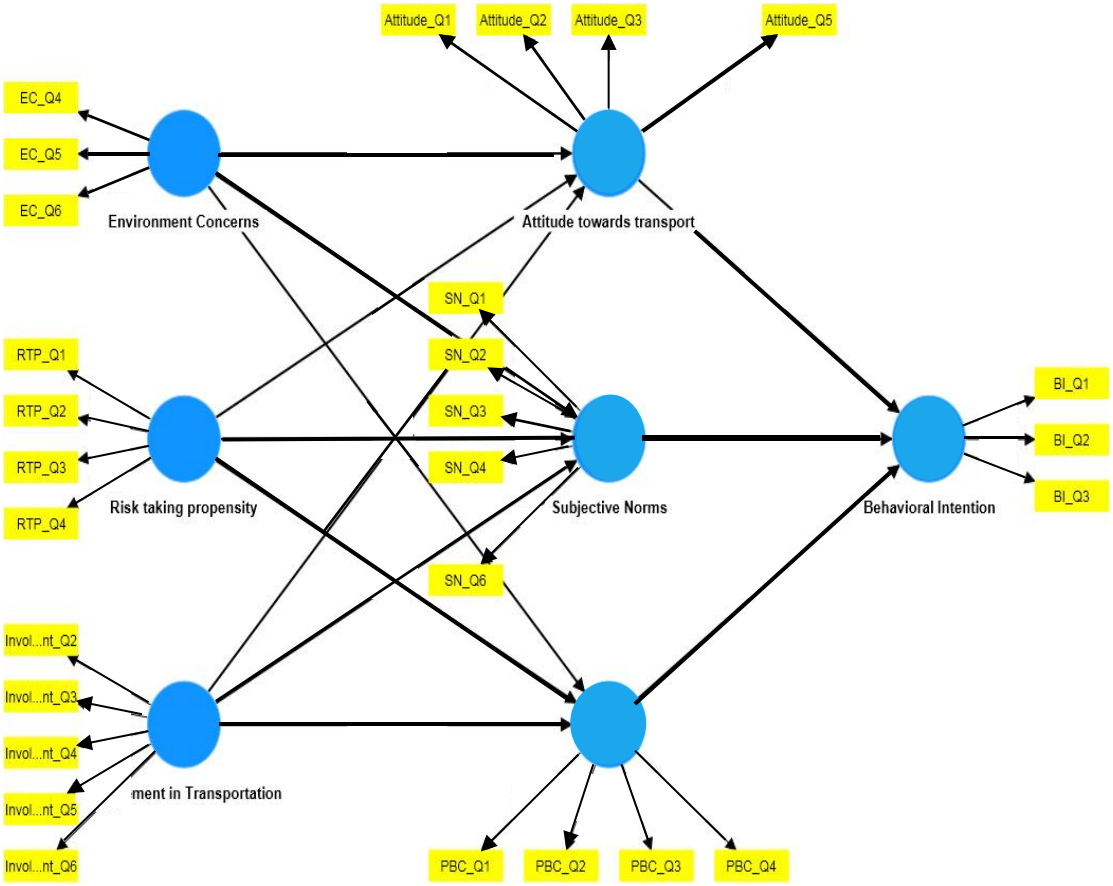


Figure 4.2 Conceptual Model

4.2.1 Measurement Model Assessment

In PLS-SEM, assessment of the measurement model (also known as the outer model) tests; composite reliability (CR) to evaluate internal consistency, individual indicator reliability and average variance extracted (AVE) to evaluate convergent validity (Sarstedt, Hair Jr et al. 2019). Validity and reliability are key in instrument development (Bacharach 1989).

4.2.1.1 Factor Analysis

The confirmatory factor analysis (CFA) in measurement model, typically first step to confirm whether the data fits the hypothesized measurement model before proceed to assess the reliability and validity of the constructs, necessitates adherence to

certain requirements to attain an accurate model (Hoyle 2012). This research employed second order confirmatory factor analysis, which is suitable for assessing construct validity and instrument reliability (Marsh and Hocevar (1988); Hatcher and O'Rourke (2013), Brown (2015). CFA provides information that can be used to assess construct reliability, such as factor loadings and error variances (Hair, WC et al. 2019) and allows review of factors, variance, and relationships between latent constructs, establishing both convergent and discriminant validity (Hill and Hughes 2007). In this study, the necessity to explore factors was eliminated as our factors were derived from pre-established ones. The Confirmatory Factor Analysis (CFA) confirmed that our factors belong to their respective variables.

Furthermore, the assessment model is required post the unidimensionality procedure. As per Awang, Ahmad et al. (2010), unidimensionality is ensured when measurement items have acceptable factor loadings for their latent constructs. Items with low factor loadings should be removed to maintain unidimensionality. For new scales, an item's factor loading should be 0.50 or higher. Some researchers may prefer established scales with a factor loading of 0.60. Items are deleted one at a time, starting with the lowest, and the model is rerun each time until unidimensionality is achieved. Marsh and Hocevar (1985) has succinctly emphasized the significance of unidimensionality: *"That a set of items forming an instrument all measure just one thing in common is a most critical and basic assumption of measurement theory."* Unidimensionality denotes the presence of a singular trait or construct behind a set of measures (Marsh and Hocevar 1985). We eliminated items with low loadings from the model framework, rather than improving them. This was done to maintain balance and ensure authentic decision-making. As shown in Table 4.2, items with factor loadings above 0.50 were retained, while the rest were removed.

Table 4.2: Confirmatory Factor Analysis (CFA)

	Attitude towards transport	Behavioral Intention	Environment Concerns	Involvement in Transportation	Perceived Behavioral Control	Risk taking propensity	Subjective Norms
Attitude_Q1	0.969						
Attitude_Q2	0.978						
Attitude_Q3	0.982						
Attitude_Q5	0.966						
BI_Q1		0.980					
BI_Q2		0.896					
BI_Q3		0.978					
EC_Q4			0.938				
EC_Q5			0.947				
EC_Q6			0.922				
Involvement_Q2				0.661			
Involvement_Q3				0.628			
Involvement_Q4				0.929			
Involvement_Q5				0.922			
Involvement_Q6				0.667			
PBC_Q1					0.973		
PBC_Q2					0.977		
PBC_Q3					0.975		
PBC_Q4					0.967		
RTP_Q1						0.865	
RTP_Q2						0.930	
RTP_Q3						0.745	
RTP_Q4						0.934	
SN_Q1							0.934
SN_Q2							0.942
SN_Q3							0.930
SN_Q4							0.776
SN_Q6							0.747

4.2.1.2 Reliability Assessment

As per Retnawati (2018) construct reliability (CR) gauges the internal consistency of variables representing a latent construct. It's used in structural equation modelling to measure the extent to which variables underlie the constructs (Zinbarg, Revelle et al. (2005). This is achievable if every variable consistently measures the same latent construct. We did a test run by using Cronbach alpha to measure, check and found the reliability of constructs.

4.2.1.2.1 Internal Consistency Reliability

Internal consistency reliability, a type of reliability assessment, is employed to evaluate the consistency of outcomes across all items within the same variables (Hair, Ringle et al. 2013). It establishes if the items measuring a variable have similarity in their scores (Hair, Black et al. 2010). The Composite Reliability (CR) is one of the methods utilized to assess internal consistency reliability. A coefficient >0.70, indicating high internal consistency and deemed acceptable (Gefen, Straub et al. 2000). As depicted in Table 4.3, the CR values for all the latent variables incorporated in this research were observed to be >0.70 (Hair, Black et al. 2010), thereby confirming the presence of internal consistency.

4.2.1.2.2 Cronbach's Alpha

Cronbach's Alpha is a measure used to assess the reliability of a set of items in measuring a construct. A α value >0.7 is generally considered acceptable (Hwui and Lay 2018). Table 4.3 shows all the study constructs have achieved Cronbach's Alpha values exceeding the required threshold of 0.7.

4.2.1.3 Validity Assessment

A validity is a measure of an instrument's accuracy in a study, encompasses four types of validations, which have been used for the study below (Mehling, Gopisetty et al. 2009).

4.2.1.3.1 Face Validity

It is the basic validity but important for pre-evaluating the survey tool for the assurance of precise and dependable data gathering has been underscored by scholars (Cheung, Cooper-Thomas et al. 2023). Before applying final version in this study, an in-depth scrutiny by three experts of the survey's matter was conducted to confirm its face validity.

4.2.1.3.2 Construct Validity

As defined by Furr (2021), construct validity measures how well a score represents the latent construct. Hair, WC et al. (2019) further clarifies it as ensuring a variable set accurately represents the theoretical latent construct. Confirmatory factor analysis' construct validity, as noted by Fornell and Larcker (1981) and Agarwal (2013), includes convergent and discriminant validity tests. These tests, as described by Campbell and Fiske (1959), are crucial for instrument development to yield psychometrically accountable data. This research reports on both these validity types.

4.2.1.3 Convergent Validity

The validity of a reflective measurement model is assessed through convergent and discriminant validity. Convergent validity denotes to the degree to which a measure correlates positively with alternative measures of the same variable (Hair, Black et al. 2010). It's based on the correlation between responses of different variables measuring the same construct (Peter 1981). Factor loading is crucial in determining convergent validity (Hair, WC et al. 2019), with a good variable showing a factor loading of ≥0.50 (Igbaria, Zinatelli et al. 1997). Hair, WC et al. (2019) recommend AVE as a measure of convergent validity, with AVE values of 0.5 or more being acceptable. In this study, the AVE values in Table 4.3 for the seven constructs exceeding the threshold AVE value of >0.50, thus fulfilling the convergent validity criteria.

4.2.1.4 Discriminant Validity

Discriminant validity, a requirement in instrument development involving latent variables (Ab Hamid, Sami et al. 2017), ensures significant conceptual differences between two constructs (DeVellis and applications. Fourth ed. Los Angeles: SAGE Publications 2017). It measures the distinctiveness of a construct from others in a model ((Hair, WC et al. 2019); Barclay (1995)), and is indicated by a not-too-high correlation between latent constructs (Peter 1981) or a low covariance factor (Kenny and Kashy 1992). Each latent construct should be unique and not highly correlated with another (Henseler, Ringle et al. 2015).

Discriminant validity is established when the correlation value of two constructs is less than 0.85 (Hair, WC et al. 2019), or when a latent variable shows more variance on a related indicator variable than it shares with another construct in the same model (Fornell and Larcker 1981). We employed the discriminant validity criteria and cross-loading scores proposed by Fornell and Larcker (1981). Table 4.4 illustrates that for all latent variables the square root of the AVE greater than the correlations among the inter-constructs (Fornell and Larcker 1981), thereby confirming discriminant validity. Moreover, the individual loadings of all indicators were observed to be greater than their respective cross-loadings (Hair, Ringle et al. 2013), providing further approval for discriminant validity.

Table 4.3: Construct Reliability and Validity

Latent Variables	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Attitude towards transport (ATT)	0.982	0.982	0.987	0.949
Behavioral Intention (BI)	0.949	1.002	0.967	0.907
Environment Concerns (EC)	0.929	0.932	0.955	0.876

Involvement in Transportation (IT)	0.867	1.016	0.878	0.598
Perceived Behavioral Control (PBC)	0.981	0.981	0.986	0.947
Risk taking propensity (RTP)	0.908	1.026	0.926	0.760
Subjective Norms (SN)	0.918	0.941	0.939	0.757

Table 4.4: Construct Validity and Discriminant Validity – Fornell and Lacker Criterion

Latent Variables	AVE	CR	ATT	BI	EC	IT	PBC	RTP	SN
ATT	0.949	0.982	**0.974**						
BI	0.907	0.949	0.191	**0.952**					
EC	0.876	0.929	0.559	0.319	**0.936**				
IT	0.598	0.867	0.606	0.309	0.489	**0.773**			
PBC	0.947	0.981	0.634	0.303	0.376	0.626	**0.973**		
RTP	0.760	0.908	0.503	0.144	0.637	0.484	0.300	**0.872**	
SN	0.757	0.918	0.653	0.421	0.461	0.501	0.734	0.352	**0.870**

Notes: $\sqrt{\ }$ of AVE: Average Variance Extracted Square Root; CR: Composite Reliability; ATT: Attitude towards transport; BI: Behavioral Intention; EC: Environment Concerns; IT: Involvement in Transportation; PBC: Perceived Behavioral Control; RTP: Risk taking propensity; SN: Subjective Norms. The off-diagonal values are the correlations between latent variables and the diagonal are the square root of AVE.

Table 4:5 Discriminant Validity

Heterotrait-monotrait ratio (HTMT) – Matrix

	Latent Variables	1	2	3	4	5	6	7
1	**ATT**							
2	**BI**	0.221						
3	**EC**	0.582	0.329					
4	**IT**	0.527	0.289	0.458				
5	**PBC**	0.646	0.288	0.393	0.535			
6	**RTP**	0.452	0.201	0.621	0.566	0.247		
7	**SN**	0.666	0.409	0.470	0.460	0.762	0.316	

4.2.1.4 Indicator Reliability

This denotes how much of the variation in an item is described by a variable. Indicator reliability was evaluated using the outer loadings. A higher outer loadings on variable show the degree of commonality between associated measure i.e. measured by the variable (Hair, Ringle et al. 2013). According to the guidelines from Hair, Hult, Ringle, & Sarstedt (2013) items with loadings >0.70 to be retained and items with loadings >0.40 but <0.70 should be carefully considered for the removal and this decision to retain or remove an item should be based on its impact on the AVE and CR of the variable. In this study, all items had loadings >0.70, except for "Involvement_Q2", "Involvement_Q3" and "Involvement_Q6" which had loadings of 0.661, 0.628 and 0.667 respectively. Despite being slightly below the 0.70 threshold, these items were retained due to their impact on the AVE and CR of the "Involvement in Transportation" construct. The removal of any item should only be considered if it results in the AVE and CR of the variable exceeding the threshold values of 0.50 and 0.70 respectively. In this case, all constructs met these criteria, suggesting that the model is reliable and valid. The next section provides an assessment of our structural model based on these findings.

4.2.2 Structural Model Assessment

After the latent variables in the measurement model have been validated for reliability and accuracy, we proceed to examine the structural model, which is also known as the inner model. This examination is aimed at understanding the relationship between endogenous and exogenous variables. The assessment of the structural model in PLS-SEM involves several key components: path coefficients are used to determine the significance and relevance of relationships within the structural model, the R-square value is used to evaluate the predictive accuracy of the model, and the f-square value is used to measure the substantial influence of an exogenous variable on an endogenous variable (Hair, Ringle et al. 2013).

4.2.2.1 Path-Coefficients

Table 4.6 and Table 4.7 shows the path coefficient for the direct relationship between Independent and Dependent Variables. Nonparametric bootstrapping routine advocated by (Vinzi, Trinchera et al. 2010), has been used on 699 data points and 5000 samples. “Bootstrapping is a re-sampling approach that draws random samples (with replacements) from the data and uses these samples to estimate the path model multiple times under slightly changed data constellations” (Hair, Ringle et al. 2013). The primary objective of bootstrapping is to compute the standard error associated with coefficient estimates. This aids in evaluating the statistical significance of these coefficients, as suggested by (Vinzi, Trinchera et al. 2010).

Table 4.6: Path Coefficients

Path Coefficients	T statistics (|O/STDEV|)	P values
Attitude towards transport -> Behavioral Intention	2.320	0.020
Environment Concerns -> Attitude towards transport	4.582	0.000
Environment Concerns -> Perceived Behavioral Control	2.022	0.043
Environment Concerns -> Subjective Norms	3.972	0.000

Involvement in Transportation -> Attitude towards transport	8.179	0.000
Involvement in Transportation -> Perceived Behavioral Control	12.590	0.000
Involvement in Transportation -> Subjective Norms	7.148	0.000

4.2.2.2 Path Coefficient Analysis

The Environment Concerns (EC) and Involvement in Transportation (IT) were found to have significant positive associations with Attitude towards transport, Perceived Behavioral Control, and Subjective Norms, supporting hypotheses H2, H3, H4, H5, H6, and H7. This highlights the importance of EC and IT in influencing these key components of the Theory of Planned Behavior. Furthermore, Attitude towards transport and Subjective Norms were found to positively influence Behavioral Intention, supporting hypotheses H1 and H12. The complexity of the transportation system necessitates collaboration among individuals to enhance its performance. Our results align with those of Ajzen (1991) and Ajzen (2020), who established a positive relationship between Attitude towards transport and Behavioral Intention. The survival of the fittest rule is also evident in our results, emphasizing the need for individuals to adapt quickly to improve Behavioral Intention. These findings echo those of (Ng 2022). Interestingly, individuals seem to place more emphasis on Perceived Behavioral Control than on Attitude towards transport when considering transportation systems, as indicated by the higher path coefficient value of the IT-Perceived Behavioral Control relationship compared to the IT-Attitude towards transport path. This comprehensive understanding of the relationships between the variables can guide the development of interventions to promote safe and efficient transportation behaviors

Table 4.7 Results of Hypothesis Testing by Structural Relationship

Hypothesis	**T statistics (|O/STDEV|)**	**P values**

H1: Attitude towards transport -> Behavioral Intention	2.320	0.020
H2: Environment Concerns -> Attitude towards transport	4.582	0.000
H3: Environment Concerns -> Perceived Behavioral Control	2.022	0.043
H4: Environment Concerns -> Subjective Norms	3.972	0.000
H5: Involvement in Transportation -> Attitude towards transport	8.179	0.000
H6: Involvement in Transportation -> Perceived Behavioral Control	12.590	0.000
H7: Involvement in Transportation -> Subjective Norms	7.148	0.000
H8: Perceived Behavioral Control -> Behavioral Intention	0.461	0.645
H9: Risk taking propensity -> Attitude towards transport	2.232	0.026
H10: Risk taking propensity -> Perceived Behavioral Control	1.152	0.249
H11: Risk taking propensity -> Subjective Norms	0.105	0.916
H12: Subjective Norms -> Behavioral Intention	6.956	0.000

4.2.2.3 Assessing R-Square (R^2) Values

The R^2 value, also known as the Coefficient of Determination, is a key metric in assessing the structural model. It quantifies the model's predictive accuracy by calculating the squared correlation between the actual and predicted values of a given endogenous construct. The R^2 values encapsulate the collective impact of the exogenous variables on the endogenous latent variables, and they also indicate the proportion of variance in the endogenous constructs that can be explained by all linked exogenous constructs (Hair, Ringle et al. 2013). In our research, the endogenous variables, specifically Att, SN, PBC and BI, have R^2 values of 0.467, 0.312, 0.401, 0.190, respectively. This suggests that the structural model formulated in this study possesses predictive relevance. Moreover, the moderate R^2 values observed upon examining the predictive power of the endogenous variables further substantiate this claim (refer to table 4.8).

Table 4.8: Results of R^2

Endogenous Variables	R-square	R-square adjusted

Attitude towards transport	0.467	0.465
Subjective Norms	0.312	0.309
Perceived Behavioral Control	0.401	0.399
Behavioral Intention	0.190	0.186

4.2.2.4 Assessing F-Square Values

The f^2 size effect is the measure to evaluate the change in R^2 value when a specified exogenous variable is omitted from the model. The size effect is calculated as:

Where R^2included and R^2excluded are the R^2 values of endogenous latent variables when a selected exogenous variable is included or excluded from the model (Hair, Ringle et al. 2013, Sarstedt, Ringle et al. 2021). An impact of a specific predictor latent variable on a specific endogenous variable shows by the f^2 size effect. In this study, the size of f^2 effect varies from small to large for all the exogenous variables in explaining the Attitude towards transport, Subjective Norms, Perceived Behavioral Control, and Behavioral Intention. The values of f^2 in our study suggest that the exogenous variables have varying degrees of influence on the endogenous variables. For instance, 'Involvement in Transportation' has a large effect size (0.424) on 'Perceived Behavioral Control', indicating a substantial impact. On the other hand, 'Risk taking propensity' has a small effect size (0.000) on 'Subjective Norms', suggesting a minimal impact. These values help in understanding the relative importance of different predictor variables in your model.

Table 4.9: Results of f-square

	ATT	BI	EC	IT	PBC	RTP	SN
ATT		0.016					

BI							
EC	0.080				0.016		0.066
IT	0.221				0.424		0.137
PBC		0.001					
RTP	0.017				0.005		0.000
SN		0.121					

4.2.2.5 Model Fit Interpretation (MFI)

The model fit indices provide a measure of how well the model fits the data. In this study, the standardized root mean squared residual (SRMR) value is 0.167, which is slightly above the recommended threshold of 0.08 (Hu and Bentler 1999), suggesting that the residuals are larger than desired.

4.2.2.5.1 Chi-square

In the context of the study hypothesis testing, the **Chi-square** statistic is used to examine if the model fits the data perfectly. The Chi-square value is 8301.807, which is quite high, indicating a poor fit. However, Chi-square is sensitive to sample size, and with a large sample size, even trivial discrepancies can produce a significant Chi-square (Green, Akey et al. 1997).

4.2.2.5.2 Normed Fit Index (NFI)

The Normed Fit Index (NFI) compares the Chi-square value of the model to the Chi-square value of a null model. An NFI of 0.710 is below the commonly recommended threshold of 0.95, suggesting that the estimated model does not improve substantially upon the null model (Yadama and Pandey 1995).

4.2.2.5.3 MFI Conclusion

In this study we investigate the impact of various factors on behavioral intention about the school transportation in Karachi. The path coefficient analysis reveals significant relationships between most of the study constructs. For instance,

'Involvement in Transportation' has a substantial impact on 'Perceived Behavioral Control', as indicated by a large effect size (0.424). However, 'Risk taking propensity' has a minimal impact on 'Subjective Norms', indicated by a small effect size (0.000). The R^2 values for the endogenous variables, specifically Attitude towards transport (0.467), Subjective Norms (0.312), Perceived Behavioral Control (0.401), and Behavioral Intention (0.190), indicate the significant amount of variance in these constructs of the conceptual model. However, the model fit indices suggest that the model could be improved. It would be beneficial to revisit the model specification by specifying additional paths or correlations, perhaps considering alternative models or additional variables that could explain the unaccounted variance in the endogenous constructs. (Schermelleh-Engel, Moosbrugger et al. 2003, Kline 2023).

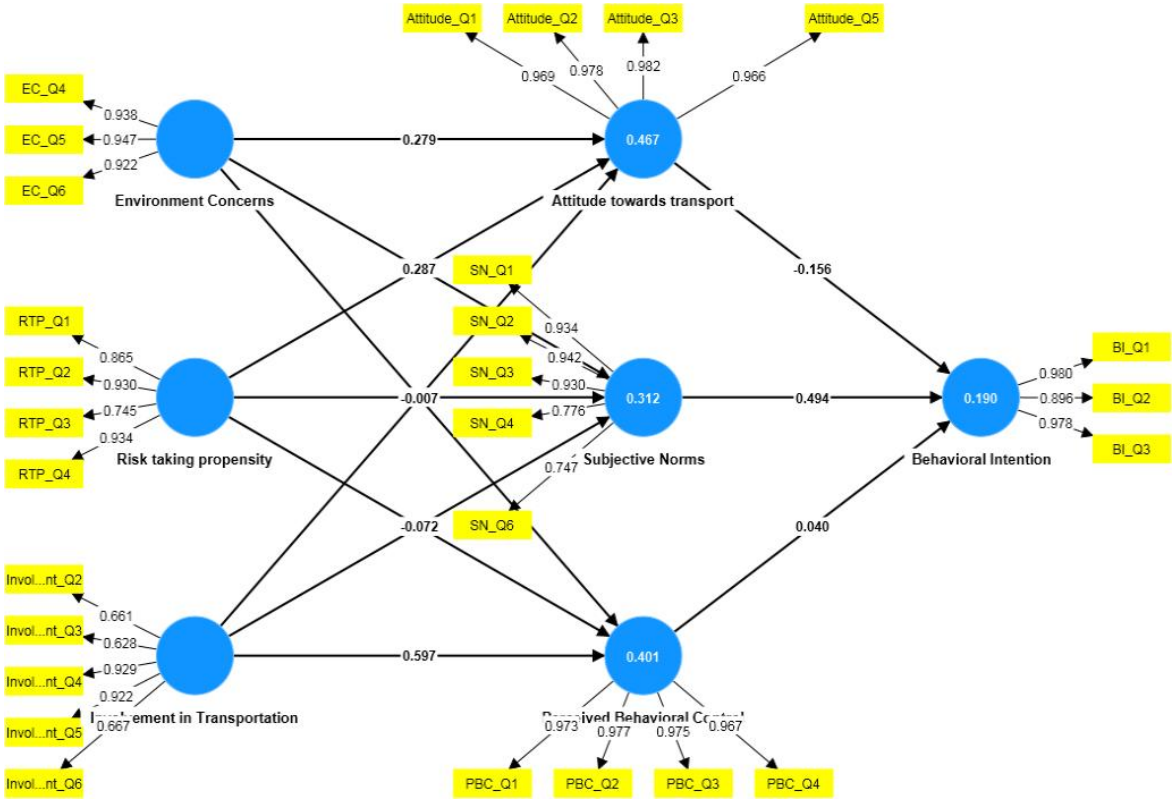


Figure 4.3 Conceptual Model

4.3 Chapter Summary

This chapter presents a comprehensive analysis of the structural equation modeling (SEM) used in the study. The SEM was employed to examine the relationships between various constructs related to school transportation, urban connotations, and disaster risk. The analysis was conducted in a systematic manner, starting with the validation of the measurement model, followed by the assessment of the structural model. The measurement model was validated using various reliability and validity tests. The constructs demonstrated high internal consistency, as evidenced by Cronbach's Alpha and Composite Reliability values exceeding the recommended thresholds. The Average Variance Extracted (AVE) values confirmed the convergent validity of the constructs. The discriminant validity was established by ensuring that the square root of the AVE was greater than the correlations among the inter-constructs. The structural model was assessed using path coefficients, R^2 values, f^2 size effect, and model fit indices. The path coefficients revealed significant relationships between several constructs, supporting the hypotheses of the study. The R^2 values indicated a moderate level of predictive accuracy of the model. The f^2 size effect showed varying degrees of influence of the exogenous variables on the endogenous variables. However, the model fit indices suggested that the model might not perfectly fit the data. Despite this, the model provides valuable insights into the relationships between the constructs and contributes to the understanding of school transportation, urban connotations, and man-made hazard risks.

4.4 Discussion

The findings of this research could inform the development of comprehensive SOPs, regulations, and rules for safe school transportation ecosystem holistically, thereby contributing to the resilience and sustainability of the urban environment. The internet-based policy analysis to identified that developed countries apply rules, regulations, or frameworks related to school transportation ecosystem at national level across the states or province bringing safety and security of school students at utmost consideration as a sensitive matter.

Our study aligns with the existing literature and support the theoretical underpinnings of the research. The study fills a gap in the literature by providing

empirical evidence on the relationships between the constructs in the context of school transportation. Interestingly, significant correlations were found between environmental concerns, involvement in transportation, risk-taking propensity, and all studied variables in this study. For instance, environmental concerns were significantly correlated with attitude towards transport ($r = 0.279$, $p < 0.001$), perceived behavioral control ($r = 0.130$, $p = 0.043$), and subjective norms ($r = 0.287$, $p < 0.001$). Therefore, hypotheses H2, H3, and H4 were accepted. Additionally, aligning with these findings, Zafar, Anjum et al. (2015) scrutinized the environmental consequences of school transport in Islamabad, outlining challenges arising from the shift of private schools and proposing sustainable solutions for the environment. Similarly, involvement in transportation was significantly correlated with attitude towards transport ($r = 0.407$, $p < 0.001$), perceived behavioral control ($r = 0.597$, $p < 0.001$), and subjective norms ($r = 0.364$, $p < 0.001$), leading to the acceptance of hypotheses H5, H6, and H7. The study by Raza, Khan et al. (2021), which explored students' behavior towards ride-sharing services in Karachi, also contributes to this understanding by addressing safety and security concerns as significant determinants, reflecting the intricate relationship between involvement in transportation and transportation attitudes. However, risk-taking propensity did not show a significant correlation with attitude towards transport ($r = 0.128$, $p = 0.026$), perceived behavioral control ($r = -0.072$, $p = 0.249$), and subjective norms ($r = -0.007$, $p = 0.916$), resulting in the rejection of hypotheses H9, H10, and H11. These findings are aligned with existing studies on attitude, subjective norms, and perceived behavioral control. The findings confirm that environmental concerns, involvement in transportation, and risk-taking propensity generate a multitude of effects on a person’s intention to use safe school transportation. The study conducted by Donald, Cooper et al. (2014) appears to align with our findings regarding the correlation between environmental concerns and various constructs related to transportation, such as attitude towards transport and perceived behavioral control. They suggest that environmental concern has an indirect influence on car usage. These differences in definitions and subsequent measures could potentially account for consistent and the inconsistent findings observed in the relationship between environmental concern and travel behavior. This highlights the need for a more standardized definition and measurement of environmental concern to ensure more

reliable and consistent research outcomes because environmental concern is found as a multifaceted concept that lacks a universally accepted definition. This suggests that environmental concern is a complex phenomenon influenced by a multitude of factors, and further research is needed to better understand these relationships as is also a key predictor of environmental concern, with younger individuals showing more concern (Jones and Dunlap 1992). This suggests that these environmentally friendly practices can be adopted independently of an individual's intentions. Utilizing public transportation is a prime example of pro-environmental behavior within the personal realm (Ertz, Karakas et al. 2016). Our study put forward a positive correlation between environmental concern and the intention to use school transport systems. This implies that individuals who exhibit a higher degree of environmental concern are more likely to express an intention to use safe school transportation system.

Chapter 5

5. Conclusion and Recommendations

This research has shed light on the complex factors influencing the intention to use safe school transportation in Karachi, Pakistan. It has revealed that environmental concern, involvement in transportation, and risk-taking propensity play significant roles in shaping attitudes towards transport and, subsequently, the intention to use safe school transportation.

5.1 Conclusions

Recognizing the challenges posed by man-made hazards and risks in the urban context, particularly in Karachi, underscores the imperative of a robust and safe school transportation system. The hypotheses, grounded in the TPB, have yielded profound insights into the nuanced relationships within the school transportation ecosystem. The study found that environmental concern among parents and university students indirectly influences their intention to use safe school transportation through its effect on their attitude towards transport, subjective norms, and perceived behavioral control. Similarly, involvement in transportation and risk-taking propensity among parents and university students indirectly influence their intention to use safe school transportation through their effect on attitude towards transport, subjective norms, and perceived behavioral control. These findings align with the TPB provide empirical evidence supporting the theory's applicability in the context of school transportation systems. Environmental concern emerges as a pivotal factor influencing attitudes, subjective norms, and perceived behavioral control regarding safe school transportation. When specifically applying the TPB to analyze risk perception and disaster preparedness behavior to aligns with our study's focus on risk-taking propensity and its correlation with attitude towards transport, perceived behavioral control, and subjective norms. The study unveils that risk-taking propensity did not exhibit a significant correlation with key variables related to school transportation. These findings, while deviating from certain existing studies, underscore the nuanced nature of risk perception and its role in shaping transportation

attitudes. This resonates with broader literature on risk perception and disaster preparedness, where risk perception plays a pivotal role in influencing intention and behavior (Ng (2022), Vinnell, Milfont et al. (2023). We can define risk propensity as a general tendency to focus more on the potential positive outcomes than on the potential negative outcomes when engaging in a behavior with undefined consequences. This definition provides a more nuanced understanding of risk propensity, capturing the complexity of this concept and its role in shaping behavior (Lopes and Performance 1984, Lopes 1987). For example, in the realm of renewable energy, this pertains to an individual's evaluation of the perceived risks involved in utilizing renewable energy technologies. This brings forth the notion of risk tolerance, which is intrinsically linked to an individual's perception of risk. The level of perceived risk and an individual's tolerance for such risk significantly influence the acceptance of a particular technology. For instance, if an individual perceives the use of renewable energy as less risky compared to other energy sources, they are more inclined to adopt renewable energy technologies (binti Aman 2011). Behavior is influenced by internal mental states rather than external conditions, and they operate on the premise that behavior is the result of a conscious, deliberative process (Ben Savage 2011), therefore if a holistic system for safe transport would be designed and apply the chances for behavioral perception will encourage positively as the need of sustainable environment is present. As an extension of TPB being enriched it through our study, this comes to notion that principally individuals behave strategically by evaluating available information and the potential consequences of their actions they intend to perform. Consequently, individuals may tend to opt for alternatives that offer the highest benefits at the lowest costs.

Moreover, the study also highlights the urgent need for disaster risk reduction strategies and their integration into urban planning and development. This aligns with the broader global agenda of achieving sustainable development goals. Furthermore, the study underscores the context by noting that this year 2023 marks the midterm reviews of both the Sustainable Development Goals (SDGs) and the Sendai Framework for Disaster Risk Reduction (SFDRR). Within this context, it asserts that the concept of *"risk-informed"* sustainable development is "no longer a matter of choice but an absolute necessity". This statement becomes particularly salient as it is essential to

ensure that everyone has a sustainable future. The GAR emphasizes the paramount significance of placing resilience-building at the heart of making a post-2030 agenda that is profoundly risk-informed (UNDRR-GAR 2023). This addresses clarity that in order to counter any unfavorable trajectory, nations and communities alike must establish systems capable of averting or effectively addressing risks. This encompasses a range of initiatives, including investments in resilient infrastructure capable of bearing the impact of disasters, the enhancement of early-warning systems to curtail losses, and the enrichment of economic and social prospects to alleviate the underlying vulnerabilities to potential hazards. Central to this effort is the coping capacity to tolerate hazards/ risks, to recover from both man-made disasters and natural hazards, and catalyze transformative change, which forms the essence of resilience (Alessi, Benczur et al. 2020). It is important that the findings of GAR special report 2023 have significant implications for the landscape within the scope of this research study on "student transportation systems", which are inherently intertwined with the broader fabric of sustainable development and build resilience. In light of the UN's call for "risk-informed" sustainable development, it becomes increasingly evident that advocating for the mitigation of potential risks and vulnerabilities within student transportation systems is not only a proactive measure but also essential in shaping a safer and more sustainable future.

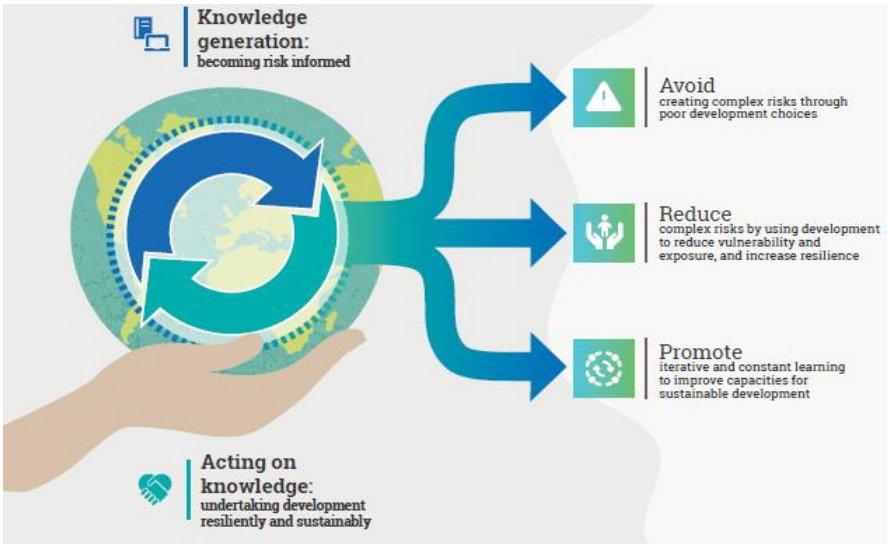


Figure 5.1: Action for resilient sustainable development. (UNDRR-GAR 2023)

5.2 Contributions and Recommendations

- This research significantly expands our perspective by providing empirical evidence on the relationships between environmental concerns, involvement in transportation, and risk-taking propensity for safe school transportation. It underscores the need for a holistic, interdisciplinary approach to address the escalating risks, potential hazards, and associated challenges in Karachi's school transportation ecosystem.
- The study contributes to understanding the factors that clearly influence the intention to use safe school transportation. It lays the groundwork for developing effective strategies to promote it. The research highlights the urgent need for disaster risk reduction strategies and their integration into urban ecosystem development. It is hoped that these findings will guide stakeholders towards a safer and more sustainable future. With some modifications, the model could have useful implications for policy and practice. The results could inform policy-making and practice in this area.
- Building resilience in Karachi's school transportation system requires not just a theoretical understanding of individual perceptions, but also a comprehensive, interdisciplinary strategy to address the multifaceted challenges posed by man-made hazards.
- The findings suggest that environmentally friendly practices can be adopted independently of an individual's intentions. This implies that stakeholders should focus on promoting pro-environmental behavior and developing effective strategies to encourage the use of safe school transportation. There is an urgent need for a holistic framework, similar to the Pakistan School Safety Framework, aimed at disaster risk reduction and the integration of such approaches into urban planning and development.
- Considering these factors, the government could initially introduce a section promoting safe school transportation in the Pakistan Safe School framework. This would focus on building SOPs, strategies, rules, and regulations that cover the complete school transportation ecosystem, including not only vehicle-

oriented but also walking and cycling (active school transport). Penalties should be put in place to highlight the sensitivity of the matter. The School Transport Safety Framework separately must be a priority though to develop and implement on the same line PSSF so that severity of potential risks and hazards can be mitigated on immediate considerations across Pakistan. It is hoped that these findings will guide stakeholders in shaping a safer and more sustainable future.

5.3 Limitation of Research

While this study offers important insights, it does come with certain limitations. The research is specific to the context of Karachi, Pakistan, which may restrict the applicability of the findings to other contexts. Moreover, the study depends on self-reported measures, which could be influenced by social desirability bias. To overcome these limitations, future research could be conducted in various contexts and employ more objective measures. This would enhance the robustness and generalizability of the findings.

5.4 Future Research

The findings of this study contribute to the existing body of knowledge and lay the groundwork for future research in this area. The research emphasizes the importance of considering a multitude of factors when understanding and addressing issues related to school transportation and disaster risk. It also highlights the need to explore methodological areas that have not been covered yet. Future research should incorporate other influencing factors to provide a comprehensive, 360-degree view of the issue. This includes considering indirect stakeholders and qualitative data. This approach will ensure a more holistic understanding of the subject matter.

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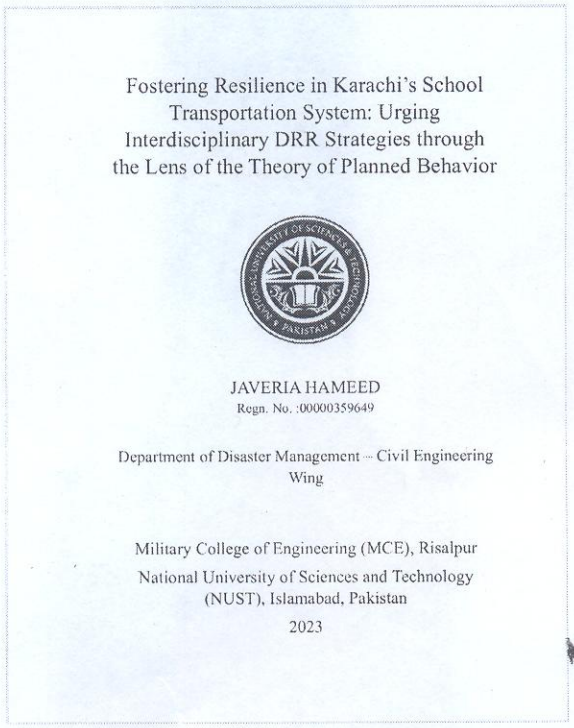

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