

The Impact of Bus Stop Designs on the Social Behavior of Student-Bus Users

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Abstract

Bus stop designs are a communal checkpoint for public vehicular transit. It has become a prominent and relevant tool in curbing traffic, as well as minimizing carbon emissions through its public services by reducing the ratio of passengers to automobile usage. Bus stops, therefore, have evolved into hubs of public significance for settlers in their businesses, schools, churches, offices as well as homes, hospitals, parks etc. In the universities, bus stops have moved from a mere option to an inevitable necessity. The rising demand by the student populace has proven to be a result of numerous factors, of which one of them is, to minimize transport expenses in the case of opting for taxis; or avoidance of fuel expenses and maintenance costs in the case of owning a licensed vehicle. It so therefore beckons for an investigation of these transit points and how their infrastructural fabrications have had an impact on social behavior of students at these locations. The study hereby seeks to make an intricate analysis, investigation and finding out how bus stops have played a major role as pertaining to the social behavior of students at these points. Naturalistic method is engaged so as not to tamper with the variables within the field of experimentation. This is achieved through research instruments such as questionnaires, interviews and documentations. The study focuses on all Kwame Nkrumah University of Science and Technology (KNUST) bus stops that see regular activity, usage, and engagement. The findings of this study provide a reasonable approach in how these checkpoints can be improved in their design in order to enhance positive social behavioral traits and minimize the negative among students.

Keywords: Bus stop, checkpoint, social behavior, automobile usage, infrastructural fabrications

INTRODUCTION

Background Study

Concerning the case of the impact of bus stop designs on the social behavior of student-bus users, briefly defined are the components of this case: Bus stop, social behavior and student-bus users. And an overview of specifically bus stop designs.

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First of all, bus stop designs are specialized locations allocated for passengers to alight or board a bus. The bus stop is the passenger's first point of contact with the bus [1]. The appearance of bus stop designs defines its usage or function. Bus locations may have a lot of shelters or seating places or it could simply be marked with a pole. These variations are based on how busy the stops are. A very busy stop would have an area for seating but a less busy stop would preferably be the marked location with a pole. Because bus stop designs and placement can vary widely within a city, from stops with a myriad of physical

landmarks (e.g., shelters, benches, trash cans, and newspaper boxes) to stops with only a pole [2]. The classification of bus stops according to the manner they are designed and placed are the curbside stops, bus bays and the nub stops. The curbside stops as the name suggests is a bus stop that is located along the curb of a road or street. The bus bay is an extension of the roadway. It is also well known as the lay-by. And lastly, nub stops are extensions towards the stretch of roadway that normally accommodate bus users upon alighting and utilizing the bus. A bus bay is a specially constructed area off the normal roadway section provided for bus loading and unloading. It is also known as a turnout or duck out. Nubs are bus stops where the sidewalk is extended into the parking lane, which allows the bus to pick up passengers without leaving the travel lane. Nubs are also known as bus bulbs or curb extensions [1]. Transit agencies are typically responsible for establishing routes, stop spacing, stop location (near side, far side, or midblock), type of stop (curbside, bus bay, or nub), bus stop signs, and amenities (such as street furniture) [1]. The curbside stops.

The history of bus stops began in England in the 17th to 19th Century. An ancient version of bus stops was used where horse drawn stage coaches stopped at designated coaching inns. At these locations, passengers boarded and alighted from the old-fashioned medium of transport of those days. Also, these stopping points were areas that provided change of the horses that were utilized in transportation.

This clearly indicates that the structures of bus stops have evolved over time. In the modern world, bus stops are normally areas that have a roof-like shelter supported on the ends. It also provides a seating place for comfort as passengers wait on the bus stops.

The case's second component is social behavior. Social behavior is defined as a set of actions and characteristics that exist among individuals. Especially individuals of the same kind or the same species. Apart from human beings, social behavior exists between animals as well. For example, the hunting of prey by wolves in a pack is a display of social behavior. The surrounding of dolphins to feed on a school of fish trapped in the centre is also one of them. Another is the hunting of multiple lions of a single prey mostly as big as a wildebeest. These different scenarios show or display different reactions of animal species to ecology or their connection with their habitat or environment. The same principle applies to the social behavior exhibited in humans. Our response to the nature, climate and surroundings around us is a proof of social behaviour. Delving into the architectural environment, our response to infrastructure, spaces, landforms, enclosures, sites, etc. is also a show of social behaviour. This literary work seeks to determine the impact of bus stop designs on the social behavior of people. So, as was discussed, it is a study to find out the response of persons or the actions and characteristics that exist specifically among student bus users in the Kwame Nkrumah University of Science and Technology (KNUST) as pertaining to the various bus stop designs.

And last but not the least, student bus-users; these are a group of people identified as passengers of the university's buses on campus. These are also the target group the research is interested in. Student bus users range according to year group and academic status in the university. There are regular students that are pursuing a Bachelor of Science degree, there are students that are pursuing a doctorate, there are students that are pursuing a masters etc. These students can also be classified based on their halls or hostels of residence, their course of study, their age, gender, etc. In conclusion, combining the three elements of the case, it can be said that the impact of bus stop designs on social behaviour of student bus users is explained and demystified to us.

Our focus for this study would place emphasis on bus stop designs since our case deals with the impact of bus stop designs on the social behaviour of student bus users. Bus stop designs, although may seem very unimportant and less critical to the built environment, contribute a lot to the modern world, especially in the transportation sector. Bus stop spacing, location, and design have a significant impact on transit system performance and customer satisfaction [1]. Bus stop designs have an impact

both on the human experience and the infrastructure of its locality. Therefore, it is of necessity that our attention be drawn to this ‘trivial’ invention which is responsible for serving as a waiting zone for vehicular transition from one place to another. By so doing, through research, analysis, concise data collection and information, we shall be able to steadily bring positive impact to the urban world.

PROBLEM STATEMENT

This research concerning the impact of bus stop design on the social behavior of student bus-users of KNUST seeks to explore the factors of bus stop design that contribute to how students behave at the bus stops. The problem under investigation concerning this research is the dissatisfaction and discomfort displayed by student bus users at bus stops; in other words, their negative social behavior towards bus stop designs. Students are gradually affected by this little instance of discomfort and dissatisfaction at the bus stops and it can over time affect their academic performance and other areas of their lives. One of the personal hypotheses of this issue through observation is the congestion that occurs at bus stops because of the increasing population. And this problem, although may seem very unimportant can over time pose a threat to the psychological wellbeing of an individual. Emphasis being made on the fact that we do not all have the same make-up intrinsically. Since structures are meant to accommodate the human experience, non-building structures must also take into consideration their social and psychological impact before they are designed. The spacing, location, and design of bus stops significantly influence transit system performance and customer satisfaction [1]. Through this research, findings on the factors of bus stop design and its impact on social behavior can set a plumline to better future designs of bus stops. Research have more often than not made mention of bus stop designs and only considered their impact to the built environment and transit system and not necessarily on social behavior of people. Therefore, I deem this research a vital contribution to the body of knowledge as we will be able to move beyond the impact of bus stops on only the inanimate and non-living to the animate and living.

In conclusion, the problem under investigation is the dissatisfaction and discomfort posed at the bus stops by bus stop designs.

RESEARCH QUESTIONS

The questions and deliberations as pertaining to this dissertation are as follows:

1. What factors influence the social behavior of student bus riders at bus stops?
2. How do we identify the factors caused by bus stop designs only?
3. What are the negative sides and positive sides of a bus stop design with respect to its impact on bus-users?
4. How do we quantify and classify the social behavior of bus users?

AIM OF THE STUDY

The aim of the study is to explore the contributions of bus stop designs towards human social behavior.

RESEARCH OBJECTIVES

Specifically, this research seeks to:

1. Discover the technicalities that go into a bus stop design.
2. Find out the factors of a bus stop design that contribute to human social behavior.
3. Explore the negative sides and positive sides of social behaviour as stemming from bus stop designs.
4. Contribute to the body of knowledge concerning the impact of bus stop designs on student bus users.

SIGNIFICANCE OF THE STUDY

This study is significant because the findings on how bus stop design affects the human social behavior would grant a solid basis to restructure and redesign bus stops for the future.

SCOPE OF THE STUDY

This research seeks to tackle the Kwame Nkrumah University of Science and Technology specifically. This research's target audience is thus limited to university students. But in detail, its scope is narrowed down to those students who make use of the bus stops whether for awaiting transportation, alighting or for recreation.

RESEARCH METHODOLOGY

The nature of the study is unsuitable to be placed in a control environment. Therefore, the method of experimentation to be utilized is the Naturalistic method. This method would enable the subjects under the study, or the target group be observed without interrupting the activities that occur naturally in that environment. Observations, questionnaires, case studies would be employed to collate the data from the target group. As well, findings from research papers, books and articles would be examined to check the consistency of data and thereby arrive at concise findings.

Research Organization

The research is structured according to the following chapters:

- *Chapter One:* It opens the research work or dissertation with an introduction that gives an overview of the entire study. Including a background, problem under investigation, the aim and objectives, the methods to be implemented in the research.
- *Chapter Two:* It is the core of the research, and it seeks to cover the topic of discussion in a systematic structure. It contains an exposition of the topic of study backed with solid arguments through findings from papers and articles.
- *Chapter Three:* This conveys the way, methods, measures and systems going to be deployed and utilized in the research to arrive at exactly accurate and concise findings.
- *Chapter Four:* This expounds on the findings and data analysis of the results of the research and its consistency to the existing body of literature.
- *Chapter Five:* The analyzed data is summarized with conclusions and recommendations.

LITERATURE REVIEW

Introduction

The literary work in this section seeks to identify and expound on the manifold aspects of bus stop designs and their relationship with the social behavior of student-bus users. A lot of examined papers as pertaining to the research would be discussed to have a holistic appreciation of the subject of the impact of bus stop designs on the social behaviour of student bus-users in KNUST. As well, the content of this section would grant answers based on the research questions developed in the dissertation. This portion of the subject would lay down problems related to the topic and justify the need to look into or research in them. Hopefully, the end result of this section is to be able to view in-depth the information that gives form and flesh to the topic under study.

Bus Stop Design

Bus stop designs date back to the inception of refined pathways in the 17th and 18th century. In that era, the medium for transportation were horses. These horses were drawn by coaches and were prevalent in European towns. The horse drawn coaches often stopped at coaching inns where horse coaches would alight passengers and pick up passengers upon arrival. As well, at these places horses were changed to ease burden on a horse which has already been utilized throughout a long journey. This can be somewhat likened to the fuel stops in the modern era but in this case the 'fuel' of these quadruped creatures is reserved at the coaching inns. For those periods, one of the notable things about transportation was that a seat needed to be booked in advance. John Greenwood is noted for opening the first bus line in Manchester, Britain in 1824. With this new phase in history, it was a bus line that ran a fixed route allowing for passengers along the way to alight and get on board. In this system, there was the absence of reservation. Over a period of time this system evolved so much that in the 19th Century in London, bus routes and bus stops could be found on maps. Now in our modern

era, the system of bus stops and bus lanes have so much advanced that they can be identified on digital maps, GPS, etc. Some bus stops have been able to also implement some tactile technologies in their surrounding environment to aid the blind. The benefit of using OSM data is that tmacs can now create tactile maps of any location in the world, including information useful to blind people such as tactile paving [3]. Tmacs are known as Tactile Automated maps creation system. And these are one of the technologies used to enhance and make convenient bus stop design. Bus stop designs in our modern era are largely instituted, assigned and developed by transit agencies. Without transit agencies there would not be any meaningful placing, planning and design of bus stops. One of the most critical aspects of transit service planning is the location and spacing of bus stops [4].

With this being established, it would be laudable to explore transit agencies and their role with bus stop design.

Transit Agencies and Bus Stops

Transit agencies are simply bodies of state or governing bodies which have been granted the sole responsibility of overseeing all aspects pertaining to public transportation in a particular vicinity. Transit agencies are also in charge of all transit operations in a specific region. They implement, plan and have control over passenger walkways, roads, bus lanes, railways, train stations etc. And especially for this study, transit agencies are a major factor to bus stop designs. In terms of how they are spaced and where they are located, which is an aspect of bus stop design. Transport agencies and their operations across the world vary due to levels of development, nature of road networks and infrastructure available, climate and legislative ordinances or decrees. Also, transport agencies apply certain standards acknowledged and accepted by their country or nation to run transit operations for a vicinity. The stop spacing standards are increasingly common in the transit industry probably reflects the often-intense conflict surrounding the location and spacing of stops [4]. The International Association for Public Transport (UITP) is an international agency that serves a large network of transit agencies across the world. It currently has 3,400 members and 92 nations on board. It was founded by King Leopold II in 1885. UITP seeks to support transport systems by bringing all transit agencies to adapt one method of satisfying transit operation needs and to provide sustainability solutions for transit systems. Transit agencies do not only consider mobility on the ground but also mobility in the air. Transit agencies are in charge of airlines and airports as well. Having grasped the general role of transit agencies, exploring their specific role on bus stop designs is needful. Transit agencies are responsible for how bus stops are spaced and where they are located. Transit agencies as was discussed earlier implement spacing systems based on stop spacing standards. These standards are designed to enhance transit system operations and bring convenience to passengers.

The Transit agency or system determines spacing by the Transport Network Design which is a subdivision of operation underneath a broad category known as Transit Network Planning. Transit Network Design, Frequency Setting, Transit Network Timetabling, Vehicle Scheduling Problem, Driver Scheduling Problem, Driver Rostering Problem are all included in Transit Network Planning. The Transit Network Design is responsible for spacing between bus stops to minimize operators' and users' costs. It defines the lines layouts and associated operational characteristics such as rolling stock types and space between stops in order to optimize specific objective functions such as the minimization of the weighted sum of operations and users' costs [5]. Frequency setting defines the times and periods of operation based on demands. It also investigates the number of trips required to meet the needs of passengers. Transit Network Timetabling tracks the arrival and departure times of all bus stops on a transit network to meet goals such as increasing the number of well-timed passenger transfers and decreasing waiting times. It also seeks to meet a given frequency and satisfy certain demand patterns. Vehicle Scheduling Problem determines the trips-vehicles to cover all planned trips while minimizing operational costs associated with vehicle use. Driver scheduling is a problem that defines daily duties that are in charge of trips while also minimizing the cost of driver wages. Driver Scheduling problem must also satisfy the demands of the labor regulation for drivers such as

maximum working time without rest and daily rest for drivers. Driver Rostering Problem has a set of generic duties that are defined over a specific time period. The Driver Rostering Problem assigns these responsibilities to available drivers based on their work schedules. The transit operations have an impact on average speeds, travel time and reliability of bus transit.

Placing and Spacing of Bus Stops in Bus Stop Design

Another thing about spacing bus stops is placing. Placing of bus stops defines the spacing. And there are three locations bus stops are placed along a transit line. They are the near-side location, the mid-block location and then the far-side location. Certain factors must be considered when positioning and spacing stops. They are as follows: adjacent land use and activities, Route of the bus (for example, is bus turning at the intersection), Impact on intersection operations, Intersecting transit routes, Intersection geometry, Parking restrictions and requirements, Origins and destinations of passengers, Pedestrian access, including handicap/wheelchair accessibility, Potential patronage, Physical roadside constraints (trees, poles, driveways, etc.), and the presence of a bus bypass lane Devices for traffic control [6].

Near-Side Stops

The Near-side location are bus stops immediately prior to the intersection. The benefits of this bus stop include reduced interference when traffic is heavy on the far side of the intersection; it allows passengers to board buses that are closest to the crosswalk, as a result, the driver has the width of the intersection to pull away from the curb, removes the possibility of double stopping, allows passengers to board and exit the bus while it is stopped at a red light, gives the driver the opportunity to check for oncoming traffic, and also other buses with potential passengers are included.

Near-side stops have the disadvantage of increasing conflict with right-turning vehicles. It causes stopped buses to obscure curbside control devices and crossing pedestrians. Cross vehicles stopped to the right of the bus may have their sight distance obscured.

Far-Side Stops

The far-side location is situated at the end of the intersection or junction. The advantage of this bus stop location is that red traffic light signal can overlap the passenger boarding and alighting time; reduces collisions between vehicles turning right and buses; increases right turn capacity by making the curb lane available to traffic; reduces sight distance on intersection approaches; pedestrians are encouraged to cross behind the bus; buses can use the intersection to decelerate, resulting in shorter deceleration distances. As a result, bus drivers can take advantage of traffic flow gaps created by signalized intercessions.

Disadvantages of near side stops are that may result in the blocking of the intersections during peak periods by stopping buses. It can reduce visibility for crossing vehicles; it may exacerbate sight distance issues for crossing pedestrians; it can cause a bus to stop on the opposite side of the road after stopping for a red light, interfering with both bus operations and all other traffic. It may increase the number of rear-end collisions because drivers do not anticipate buses stopping again after stopping at a red light. When a bus stops in the travel lane, traffic may become backed up into the intersection.

Mid-Block Stops

Bus stops within the block are called Mid-block stops. The benefits of these stops include reduced sight distance issues for both vehicles and pedestrians. It can result in passenger waiting areas experiencing less congestion.

Disadvantages include the additional distance required for no-parking restrictions. It encourages patrons to cross street at mid-block (jay walking) and increases the walking distance for customers who cross at intersections.

In conclusion, the near-side stop, far side stop, and mid-block stop are stops classified based on their spacing and location which is an aspect of design. Bus stops can also be further classified based on their intrinsic design and zone.

Types of Bus Stops According to Zones

There also types of bus stops according to zones and how they are designed. Bus stop zone is an area or region along the roadway designated for alighting and boarding passengers. Bus stop zones across the world are not the same. And so therefore, they differ with transit agencies. Bus stop zones have specific dimensions that are used in their layout. In general, bus stop zones for far-side and near-side stops are 90 and 100 ft, respectively, while midblock stops are 150 ft (Directives for the placement and design of bus stops). Based on an in-depth study of bus stops categorized based on their zones, they are: curbside stop, Bus Bay, Open bus bay, Queue Jumper, and Nub stop.

Bus Bays

A bus bay also known as turnout is a specially designed location or area which is located away from the normal roadway and allows for the boarding and alighting of passengers. This kind of design allows traffic to flow freely without inhibition since the bus veers off the normal roadway to serve passengers. They are normally put on high-volume and high-speed roadways like the sub-urban arterial roads.

They are also constructed in heavily congested areas where passengers are likely to utilize the services of a bus bay.

The following elements must be considered when designing bus bays: Traffic in the curb lane exceeds 250 vehicles during peak hours. The speed of traffic exceeds 40 mph. Bus volumes on the highway are 10 or higher per peak hour. Passenger volumes are greater than 20 to 40 boardings an hour. The average peak period per bus exceeds 30 sec. Buses are expected to stop at the end of their journey. Due to potential of bus conflicts there is a need for separation of passenger vehicles. History of pedestrian accidents at stop location. The width of the right of way is adequate for constructing the bay without interfering with pedestrian movement on the sidewalk. Due to sight distances, traffic is prevented from stopping behind a stopped bus. Buses use the right-turn lane as a queue jumper lane. An intersection has proper bus signal priority treatment.

The bus bay stops have the following advantages: they allow passengers to board and alight outside of the normal roadway; provides a safe haven for both the stopped bus and the bus passengers; and reduces traffic delays. Disadvantages of the bus bay stops are that: It a pose problem to bus drivers in an attempt to reenter traffic. It is more expensive to implement than curbside stops. It is also difficult and expensive to relocate it.

Curbside Stops

It is located on the outside of the main lane along the curb. Because the stop is on the road, conflicts between moving traffic and stopped buses are possible.

The curbside stop has the following advantages: it provides easy access for bus drivers and results in minimal bus delay. It is simple in design and cheaper to implement. It is easy to relocate. Disadvantages of the stop is that it can easily cause traffic congestion to occur since other vehicles would have to come to a hiatus behind stopped buses. It can also compel drivers to make very risky maneuvers when changing lanes.

Nub Stops

This is the area or region that extends from the parking lane's curb into the normal roadway. Nubs are used both to calm traffics and as bus stops. When used as bus stops, buses stop in the roadway

instead of veering off it. Therefore, they operate like the curbside stops. Nubs provide an additional area for passengers to walk around and for curbside amenities like shelters and benches.

The Bus-User Experience

These classifications of bus stops in terms of placement and zones affect the bus-user experience and satisfaction. It must be understood that bus stops serve as a temporary dwelling place for passengers waiting at stops unlike with homes that serve a permanent purpose. And just as the enclosure of a house affects user comfort and experience, so also does the bus stop affect the passengers' comfort and experience at the stop. Based on observation and geographical facts, in this part of the world, where we inhabit a tropical environment, one limitation in experiencing comfort at the bus stop is the intensity of solar radiation throughout the year. And this is one of the factors that affect the social behaviour of bus-users at transit stops. In the preliminary exploration of this subject, it was made mention that bus stops which are noted for being less busy were often simply marked with a pole. Bus riders often find these bus stops to be quite uncomfortable, especially when there aren't many buses available and they have to wait for hours until one comes. These bus stations are more exposed to sun radiation compared to the surrounding neighbourhood. Based on observation, these effects of solar radiation arouse in bus users feelings of anger, irritation and unrest. One of the measures incorporated to reduce and alleviate such exposure to the sun is the planting of very tall shading trees around that region. This helps to give the user a more comfortable experience. And contributes to maintaining feelings of rest and calm whiles users await their vehicle.

Another factor that contributes to bus user behaviour at the bus stop is the turbulence of wind. As trivial and petty as it may sound, the velocity of wind at transit stops has a contributing influence to how bus users behave at the bus stops. As was earlier mentioned concerning this tropical part of the world, temperatures in this vicinity and location are normally very high. These high temperatures cause irritations at the stops. Especially stops which are not well shaded. One of the things the wind contributes is that it is able to cool down areas with such high temperatures. Moderate wind speeds will therefore help to alleviate the feelings of irritation and unrest caused by the solar radiation from the sun by cooling bus users at the transit stops. But one of the disadvantages about wind speeds is that, when they tend to become very excessive, they can be a nuisance instead. They can tend to carry off dust into the eyes of bus users at transit stops especially during the period of 'harmattan' in the year. Stops which are laid bare and have no adequate location would tend to suffer a lot from this phenomenon of the wind. For example,, A stop which is simply marked with a pole and located on a very bare stretch of land will be prone to the hazardous impacts of the wind. But such a same stop when located at a place with numerous trees would have the trees serve as wind breaks that would help alleviate, reduce and diminish the impact of the wind in that environment. Temperature and windspeeds have an impact on behaviour of bus users. With mean daily temperatures of 17°C in January, it is no surprise that climatic conditions like temperature and wind speed influence bus passenger walking distances and waiting times in northern cities like Calgary [7].

RESEARCH METHODOLOGY

Introduction

The research about the impact of bus stop designs on student bus users would utilize primarily a naturalistic method. This means the experimenter would make a close observation of the subjects in the space without making known their intentions. The research approach in making these findings would take on both a qualitative and quantitative approach. In the qualitative sense, the data collected would bring to light the dominant traits of behaviour expressed at the bus stops. And in the quantitative sense, the data collected would help determine the number of participants who express a dominant trait [8–10]. The research strategy to be utilized is by first of all, implementing a case study on different bus stops. Secondly, a case study of the bus stops in KNUST will be conducted. Then thirdly, observation of bus-users and recording their dominant traits based on how they behave at the bus stops. And then by the use of questionnaires and interviews for subjective information which can

be weighed against the naturalistic method to see the closeness of their correlation. The sample to be selected would range from different bus stop locations in the country and then primarily the bus stops of the KNUST campus. The ethical consideration in the use of this method is not to interfere with personal information of subjects outside the research of study. The limitation of this project as pertaining to the subjects are the bus-users.

Research Strategy

The research strategy is implemented by first preparing all data collection tools and equipment. The first thing to be done would be a case study of various bus stops in the country of Ghana; at least two different bus stops. This is to help decipher the results that vary and the results that remain constant in the research. When this is achieved, a case study is implemented at the target location which is the KNUST campus. And the results of this case study on the bus stop helps us to determine the extent at which it varies from other bus stops and what it lacks or possesses that other bus stops do not. Then following this method would be the implementation of the naturalistic method at the target location, which is the KNUST bus stops. The subjects at the bus stops would be observed and certain traits would be identified. Varying traits would be categorized and analysed. Then finally, subjects would be granted a questionnaire to provide their own subject information as pertaining to their behavior at the bus stops.

Research Method

Primarily the use of the naturalistic method would be implemented. This is to make sure that subjects do not recognize they are being studied on in order not to cause a Hawthorne effect through expressing social bias characteristics. Therefore, the experiment would be carried out by adorning oneself just like a bus-user awaiting at the bus stop.

Research Approach

The research approach as discussed before would take on both the qualitative and quantitative approach. This is due to the fact that the research is both qualitative and quantitative in nature. The qualitative approach would help determine the dominant traits which occur with bus-users at the stops and the quantitative approach would help determine the number of people who would be exhibiting a particular trait at a point in time at the bus stop.

Data Collection Method and Tools

The tools to be used would be by observation through the naturalistic method, questionnaires and interviews as the need would arise.

Questionnaire

(The Department of Architecture of the Kwame Nkrumah University of Science and Technology)

This is a research instrument that seeks to find out the student's response towards comfort at bus stops and the influence of bus designs on their behavior.

The Impact of Bus Stop Designs on the Social-Behaviour of Student Bus-Users

Section 1

1. Profession

☐ Student

☐ Non-student

2. What position would you like to be in at the bus stop?

☐ Sitting

☐ Standing

3. Do you find the bus stop comfortable?

☐ Yes

☐ No

If yes, select any reasons that make the bus stop comfortable?

- ☐ Has a shade ☐ Has a seating area
☐ Has a good view Other.....

4. Select the factors that you think are an influence on your comfort at the bus stop

- ☐ Sunlight ☐ Presence of people
☐ Bus stop design ☐ Trees

5. Have you ever been angry at the bus stop because of its location and design?

- ☐ Yes ☐ No

If yes, what caused it

- ☐ Location of bus stop ☐ Design of bus stop
☐ Both ☐ If other, specify

6. What kind of bus stop would you want?

- ☐ Shaded stop ☐ Unshaded stop

7. Would you have preferred a better location of any bus stop on campus?

- ☐ Yes ☐ No

8. Has there been anything that has obstructed your comfort at any bus stop on campus?

- ☐ Yes ☐ No

Section 2

9. On the scale of 1–5, rate the comfort of these bus stops

Bus stop on campus

Scale (1–5)

Bus stop at hall 7

Bus stop at pharmacy block

Bus stop at destiny building

Bus stop at Brunei taxi rank

10. What feature of a bus stop do you find most comforting

- ☐ Silence ☐ Shade
☐ People present ☐ Seating area
☐ Location if other, specify

11. Which of the bus stations do you think is the best. In terms of comfort

- ☐ Bus stop located beside Pharmacy block
☐ Bus stop located beside Destiny building
☐ Bus stop located beside Hall
☐ Bus stop located beside Brunei taxi rank

12. Select the other factors you think makes the bus stop you have chosen the best. In terms of comfort?

☐ Ease of Access

☐ Good location

☐ Convenient for transit State any other

THANK YOU

DATA ANALYSIS AND FINDINGS

Introduction

The analysis and findings from 305 questionnaires completed by both students and non-students on KNUST campus. The goal of this study was to identify bus stop design factors that influence the social behavior of student bus users. The objectives of the study were to identify the student's preference of bus stop design, the student's general wellbeing at the bus stop and the link between bus stop design and student's social behavior.

Questionnaires were given to students and non-students on KNUST campus via an online form over a short period of time. Data collected was automatically ordered analytically by bar charts and pie charts via the online form. The data collected is organized in two main sections. The first has to do with one's individual preference of an ideal bus stop and secondly, one's comfort at the bus stop. For a sub-section of these two main studies, a short data analysis capturing both particular groups were highlighted.

Personal Data

This is the section that captured the particular group involved in the questionnaire. The groups were organized in the category of their academic status. Whether student or non-student. This was to find out if findings for both students and non-students would be the same or would have certain changes.

Academic Status

According to the data collected of the 305 responses, 97.7% of the responses were students and 2.3% of them were non-students (Table 1).

Table 1. Academic Status near here.

Academic status	Number	Percentage
Student	298	97.7
Non-student	7	2.3

Bus Stop Preference

This is one of the main sections that deals with the target's preference of what they would want at a bus stop and what they want the bus stop to be. This is based on specific questions asked to them.

Posture at Bus Stop

Table 2 shows POSTURE AT BUS STOP responses. It was necessary to discover what posture one would prefer at the bus stop since it helps us see their preference of what they see as a comfortable state and position at the bus stop.

Table 2. Posture at Bus stop near here.

Posture at bus stop	Number	Percentage
Sitting	267	87.5
Standing	38	12.5

General Comfort at Bus Stop

It was important to find out the general opinion about comfort of bus stops to understand if bus stop designs on campus are actually having a positive impact or negative impact. According to the table, majority find the bus stops comfortable (Table 3).

Table 3. General Comfort at Bus stop near here.

Comfort at bus stop	Number	Percentage
Not comfortable	123	40.3
Comfortable	182	59.7

Reasons that Make Bus Stop Comfortable

Highlighted in Table 4, are the reasons that make the bus stop comfortable. The major reason given here is with regards to shade. Followed by possessing a seating area.

Table 4. Reasons that make Bus stop comfortable near here.

Reasons	Frequency	Percentage
Has a shade	199	65.4%
Has a seating area	155	50.5%
Has a good view	70	23%
Other	35	0.3%

Factors that Make the Bus Stop Comfortable or Not

Highlighted in Table 5, are the factors that make the bus stop comfortable or not. The major influence towards individuals is sunlight. This data corresponds with the previous information that had a majority selecting shade as a major factor in comfort of a bus stop design

Table 5. Factors near here.

Factors	Frequency	Percentage
Sunlight	152	49.8%
Presence of people	116	38%
Bus stop design	103	33.8%
Trees	72	23.6%

Anger at Bus Stop Based on Its Location and Design

Further data collection concerning their social behavior and specifically if they have had any agitations at the bus stop. Data reveals that a majority have been one way, or another angered at the bus stop (Table 6).

Table 6. Anger at Bus stop near here.

Anger at bus stop	Number	Percentage
Angered	171	56.1%
Not angered	134	43.9%

Causes of the Anger at the Bus Stop

Highlighted in Table 7, are the causes of this feeling of agitation at the bus stop. A majority being none because individuals are generally affected by agitations of external influence outside the bus stop design. But the second highest selection reveals that location of bus stops are one of the reasons to the agitation.

Shaded Stop or Unshaded Stop

Highlighted in Table 8, we examine a facet of bus stop design that has to do with shading. An outstanding majority has a greater preference for shaded stops over unshaded stops.

Table 7. Causes of Anger near here.

Causes of anger	Number	Percentage
Location of bus stop	63	20.7%
Design of bus stop	51	16.7%
Both	61	20%
None	115.9	38%

Table 8. Shaded stop or unshaded stop near here.

Type of bus stop	Number	Percentage
Shaded stop	301	98.7%
Unshaded stop	4	1.3%

Preferences for a Better Location of any Bus Stop

In further probing into the location of bus stops on campus as an issue, it is realized that a majority of individuals consent that the bus stops could have a better location (Table 9).

Table 9. Better Location of Stop near here.

Better location of stop	Number	Percentage
Consent	193	63.3%
Disagree	112	36.7%

Comfort at the Bus Stop

Comfort at the bus stop is the next section of the data collection procedure. And in this section, there is much more detail and specification into the individual's choices.

Obstruction of Comfort at the Bus Stop

Highlighted in Table 10 is data to find out if individuals consent or disagree concerning the obstruction of their comfort at the bus stop. A majority consent to the fact that their comfort at the bus stop is one way or another obstructed.

Table 10. Obstruction of Comfort near here.

Obstruction of comfort	Number	Percentage
Consent	223	73.1
Disagree	82	26.9

Rating of Certain Bus Stops on Campus Based on Comfort

In the gathered data in Table 11, there is a rating principle based on a scale to determine the comfort of specific bus stops on campus. The highest value on the scale interprets as very comfortable. The lowest value interprets as not comfortable. The median value on the scale interprets as averagely comfortable or comfortable (Table 12–14).

The criteria of rating of bus stops on campus based are as follows:

- *Bus stop at hall 7 is rated on a scale of 1 to 5.*
 - *Bus stop at Hall 7 is majorly rated as averagely comfortable.*
- *Bus stop at pharmacy is rated on a scale of 1 to 5.*
 - *Bus stop at Pharmacy is majorly rated as not comfortable.*
- *Bus stop at Mecca Road is rated on a scale of 1 to 5.*
 - *Bus stop at Mecca Road is rated majorly as not so comfortable.*
- *Bus stop at Brunei taxi rank is rated on a scale of 1 to 5.*

Table 11. Rating of certain bus stops on campus based on comfort.

Rating	Number	Percentage
1	16	5.3%
2	36	11.8%
3	141	46.4%
4	76	25%
5	35	11.5%

Table 12. Ratings, Bus stop at pharmacy.

Rating	Number	Percentage
1	134	43.9%
2	73	23.9%
3	62	20.3%
4	25	8.2%
5	11	3.6%

Table 13. Bus stop at Mecca Road.

Rating	Number	Percentage
1	87	28.5%
2	83	27.2%
3	77	25.2%
4	44	14.4%
5	14	4.6%

Table 14. Rating, bus stop at Brunei Taxi Rank.

Rating	Number	Percentage
1	9	3%
2	39	12.8%
3	119	39%
4	94	30.8%
5	44	14.4%

- *Bus stop located at Brunei Taxi rank is rated as majorly averagely comfortable.*

Amongst these bus stops, what is most intriguing about the data collected is that the bus stop located at Hall 7 and the bus stop located at Brunei Taxi rank are rated as averagely comfortable. What is also realized through previous data collected is that there is a strong preference in terms of design for shaded stops. And these two stops possess a shade. This could be a contributing factor to why these bus stops were chosen.

Feature of the Bus Stop that is Found Most Comforting

In the data shown in Table 15, It is noticed that the major feature found most comforting at the bus stop is the shade.

Table 15. Feature of the bus stop that is found most comforting.

Features	Frequency	Percentage
Silence	44	14.4%
Shade	228	74.8%
People present	22	7.2%
Seating area	182	60.7%
Location	58	19%

Best Bus Stop in Terms of Comfort

In Table 16, It is realized that the best bus stop chosen is the Brunei taxi rank. The reason for this choice is the shade factor as mentioned earlier before. But another reason preference here is greater than the bus stop at Hall 7 may be that majority of the participants in this survey are residents of Brunei.

Table 16. Rating on bus stop in terms of comfort.

Bus stops (location)	Number	Percentage
Pharmacy block	16	5.3%
Mecca road (shuttle rank)	42	13.9%
Hall 7	113	37.1%
Brunei taxi rank	133	43.7%

Factors that Make the Bus Stop the Best in Terms of Comfort

In Table 17, it is discovered of the factors observed to make a bus stop the best. Majority consent to the fact that a good bus stop requires a good location.

Table 17. Factors that make the bus stop the best.

Factors	Frequency	Percentage
Ease of access	152	49.8%
Good location	192	63%
Convenient for transit	154	50.5%
Good ventilation	2	0.7%

Conclusion

The aim of the study is to discover the factors of bus stop design that contribute to human social behavior. Findings for the subject have been summarized in each section.

CONCLUSION, INTERPRETATION AND DISCUSSION

Introduction

In this paper, the interpretation of the data collection is discussed. In this research, some limitations of the study are identified. The impact of bus stop designs on the-social behavior of student bus-users is realized here based on the interpretation of the data.

Summary of Research

The purpose of the study on the influence of bus stop designs on the social behaviour of student bus riders was to ascertain whether or not bus stops and the way they are built do in fact affect the comfort of student bus riders.

Objective 1: Discover the technicalities and construction methods that go into a bus stop design

From the findings of the research, technicalities discovered from the bus stop are that bus stops can be classified based on two different categories; they can be classified according to spacing or according to zoning. According to spacing, there is the nearside stop, far side stop, and the mid-block stops and according to zoning there is the bus bays, curbside and nub stops. Bus stops also are not just put up by individual persons or simply just anyone. They are planned by the transit agency of the vicinity.

Objective 2: Find out the factors of a bus stop design that contribute to human social behavior

According to data collected via questionnaires, the underlying factor that contributes to human social behavior is the shade of bus stops. The others do not have as strong an influence like the former. Some of them are location of bus stop, seating area, ease of access, and convenience of transit.

Objective 3: Explore the negative and positive sides of social behavior as stemming from bus stop designs

Negative side of social behaviour according to findings has to do with aggression. The positive side has to do with amiability. And these traits although may have other external influencing factors also have roots in the manner with which bus stops are built according to data collected from respondents.

Objective 4: Contribute to the body of knowledge concerning the impact of bus stop designs on student bus users

Bus stop designs have an impact on student social behaviour. Research has brought the understanding that bus stops are seen just simply as a region for transiting, but they have more influence on the lives of individuals than it is thought and understood.

Conclusions

According to the findings of this research and the opinions of those who responded to the survey, it is discovered that bus stop design indeed has a direct correlation with the social behaviour of student bus-users.

Recommendations

- Bus stops should possess shade as much as possible.
- Bus stops should have a seating area.
- Bus stops should have very good locations.
- Bus stops should be designed taking into consideration the social behaviour of individuals.

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