An Investigation of the Perception of Dalhousie University Undergraduate Students on Green Transportation Use To and From Dalhousie's Studley Campus.

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Key words

Bicycling | Green campus | Green transportation | Shared mobility | Electric vehicles | Emissions

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Executive summary

We conducted a survey to verify the practicality of green transportation on campus and to understand the perspective of Dalhousie University students on green transportation for use to and from its Studley campus.

The results indicated that the majority of the respondents commuted to and from campus by foot or by bus, and most of them found their current modes of transportation to be convenient enough. Additionally, the majority of respondents did not own electric bikes or scooters and were not familiar with charging stations. It became known that the majority of people believed that the absence of bike lanes would cause the respondents to feel uneasy and discourage them from using bicycles as a mode of transportation. The problem of the road also showed up in the fear of being hit by automobiles and exhibit road rage, which has made many doubt eco-friendly modes of transportation like bicycles. It was further determined that a large drawback of green transportation is that people don't understand it well enough. It is believed that the likelihood of increased E-bikes usage is higher if the state of the roads is improved, and more people are aware of them. From this study it was found that increased bike storage on Studley campus, increased bike lane infrastructure and increased marketing could provide the most effective allocation of resources with the goal of increasing green transportation uptake from Dalhousie Students on Studley campus.

Introduction

Green transportation

With the increasing threat of climate change and our need to move towards sustainable practices and away from greenhouse gas (GHG) emitting devices, green transportation has become a large area of focus for limiting emissions. Green transportation, or sustainable transportation, refers to transportation methods that do not depend on natural resources as fuel sources. Accounting for approximately $1/5^{th}$ of CO2 emissions (the largest contributing GHG to climate change), transportation needs to shift from burning fossil fuels to more sustainable energy sources and modes of transportation (Our World in Data, 2020). According to the IPCC report (2023), to limit global warming to 2° C by the year 2100, drastic reductions in GHG

emissions is required and with 1/5th of CO2 emissions and 17% of global GHG emissions, transportation must be targeted in order to meet these goals.

As the global population grows, cities expand, and global connectivity develops, demand on transportation increases and GHG emissions continue to spike (Li, 2016). To address this problem, greener forms of transportation need to be considered and strategically implemented to allow for more sustainable movement of people, goods and services. In order to do so, the perspective of residents and businesses need to be considered to effectively implement greener mobility services and each type of green transportation needs to be considered for different environments. Recently, electric vehicles have faced backlash regarding their life cycle and total impact on earth with regard to raw resource extraction and recyclability of the device following its use (Jones et al, 2020). In Canada, while urban areas are exponentially adopting the movement of electric vehicles, the short range of these vehicles has faced pushback in the many rural areas of the country due to the wide expanses between charging stations and slow growth of public charging infrastructure (KPMG, 2020). Additional frustration in mid-sized North American cites has become prominent regarding lack of bike lanes and lack of safety on vehicle dominated roads. This has resulted in slow uptake of the transportation method. In contrast bicycling in Europe has seen great uptake in recent years with 15-40% of trips using this form of transportation (Geurrieri et al, 2019). understanding populations and societies' needs and culture, more effective strategies can be implemented to increase the use and efficiency of greener methods of transportation.

Strategies on campus

Described as small-scale models of cities, university campuses provide great opportunities for studying lifestyle changes and patterns within a community (Geurrieri et al, 2019). University campuses encompass a diverse population of individuals and contain many micro-communities with differing values, needs and cultures. By investigating university campuses, researchers can capture a wide range of perspectives when studying the effectiveness of implemented services and allow for better strategies to be formed when widening implementation in the larger surrounding communities or cities (Geurrieri et al, 2019). New literature is emerging as electric scooter (e-scooter) and bike share programs are becoming more popular for modes of transportation across North America. These sharing programs use GPS

coordinate systems to track devices for payment and allow for them to be left at various drop off locations, removing the need for them to be station based (Kellstedt et al, 2019). There have only been a few studies published with focus on shared mobility services and their impact on universities. Most notably, two cross sectional surveys were used (before and after) the launch of a shared e-scooter mobility service at the Virginia Tech campus in Blacksburg, Virginia. Being able to assess a pre- and post-launch comparison from survey results revealed that the main demographic of users were younger students in their undergraduate degree (Buehler et al., 2021). Additional literature has highlighted the uptake in bike-sharing programs on campus with notable results. One university (Texas A&M University) saw a bike-share mobility program use rate of 33% by students with 19,504 registered users of the program. Similarly, younger undergraduate students were the most active in the program (Kellstedt et al., 2019).

While usage rates of mobility sharing programs are rising, many concerns regarding safety, lack of infostructure and road use knowledge have been expressed (Kellstedt et al, 2019). Understanding the perspectives of green transportation users on limitations of accessibility and comfortability are crucial to implementing effective strategies to increase the percent of mobility share program users on campuses. Ultimately, understanding university students will give insight into the barriers to utilizing more sustainable modes of transportation and assist in using resources effectively to break them down.

Understanding student perspectives

With increasing urbanization in Canada and Halifax representing one of the fastest growing cities in the country (Statistics Canada, 2022). Dalhousie University in the center of the city of Halifax provides a great model in understanding the perspectives of residents on greener modes of transportation. With increasingly high living costs around Halifax, Nova Scotia, a greater demand for transportation to and from the Dalhousie campus will be needed as many students are having difficulty finding affordable housing near Dalhousie's largest campus (Studley Campus). Having a greater demand for transportation to and from Dalhousie University and the students' place of residence comes with increasing greenhouse gas emissions from vehicles and buses powered by fossil fuels. Dalhousie has a large population with over 20, 000 students enrolled at the University, in addition to their faculty and staff (Dalhousie, 2021). This large number of frequent visitors to campus comes with great greenhouse gas emissions released

from fossil fuel powered vehicles and buses. Focusing on shared mobility service modes of transportation like shared electric scooters or bikes could reduce Dalhousie's environmental footprint, and the amount of greenhouse gas emissions being released by fossil fuel powered forms of transportation. Shared electric scooter and bike programs have been implemented in many cities across North America, which is encouraging new research on the subject (Moosavi et al., 2022).

Project breakdown

To understand the perspective of students studying at Dalhousie University's Studley campus on limitations to accessing and utilizing green transportation and implementing mobility share-programs a survey focused study was conducted. In order to implement green transportation uptake strategies, our primary research goal was to determine how undergraduate students perceive access, safety, and storage of active transportation on bikes and e-scooters to Dalhousie University's Studley campus and back to their house of residence or workplace. To gain insight into this population, the study concentrated on comprehending the important perceptions of students on campus through a questionnaire.

Methods

Setting

This study took place on Dalhousie University's Studley campus. This is Dalhousie's largest campus and hosts the majority of its 20,000 students annually (Dalhousie, 2021).

Study Design

Prior to data collection, a minimum sample size was calculated to ensure assumptions were met for statistical analysis. With limited access to Dalhousie enrollment, the total Dalhousie University undergraduate population was used as the population estimate and sample size with a 95% confidence interval was calculated. This resulted in a needed sample size, and thus survey response rate of 387.

Using Dalhousie's Research Ethics sample consent form for participation in an online survey (no signature requested), we edited it to fit with our survey and the requirements needed.

A link to the consent form was inserted into the beginning of our online survey, followed by a Y/N question whether the participant consents to taking the survey.

A survey was then designed in Microsoft forums to provide insight into the accessibility to, limitations of, and storage of green transportation devices on campus. Further questions related to demographics of the respondents and their current modes of transportation. To do so, multiple question types were utilized such as categorical, rating, and likert scale to standardize answers and understand respondent consensus. Open ended questions were also used to provide an opportunity for respondents to share opinions and ideas not listed in previous questions. This was crucial in understanding gaps in the survey's inclusion of potential limitations regarding green transportation on campus. The survey was broken down into five categories of questions and was comprised of 19 optional questions to address these (Appendix 1).

- Consent
    - Question 1 was used to guarantee consent from participants following reading the consent form provided.
- Respondent demographics
    - These questions (2-5 & 19) were used to determine characteristics of students analyzed in the study and to gain insight into any biases that may have resulted from shared backgrounds of individuals.
- Current methods of transportation
    - Questions 6 & 7 were utilized to understand the lifestyles of students and their current method of getting to campus.
- Perspective on mobility sharing programs
    - Questions 14 & 15 sought to gain insight into the interest of student's potential use of bike and e-scooter mobility sharing programs.
- Knowledge of current green transportation initiatives
    - Questions 12 & 13 address the knowledge of students about current green transportation initiatives on campus
- Campus limitations regarding green transportation

- Questions 8 – 11 & 16-18 addressed current limitations, problems with accessibility and safety barriers associated with green transportation and current green transportation initiatives accessible to students.

The survey was active for a total of 8 days, and responses were collected anonymously. The study used probabilistic sampling as the goal was to generalize back to a well-defined population (Studley campus undergraduate students). Here a simple random sample was used and each undergraduate student on the Studley campus had an equal chance of being included. For the specific goal of understanding student perspectives across campus and within different communities, a survey was chosen for data collection over interview or audit. This allowed for a breadth of students to take part in the study anonymously and allowed for more students to take part as both an audit and focus group would have gained more information but from a smaller group of individuals. This may have hindered representation of the wider student perspective. It also allowed for anonymity of respondents and was inexpensive.

To market the study and collect responses a poster with the studies goals and QR code and link to the survey was created (Appendix 2). This was forwarded to Dalhousie's Studley campus professors to post on class webpages and share in lectures. A total of 5 professors were contacted who shared the poster to their class using the methods previously described. Additionally, each researcher reached out to student peers and sports teams who study on Dalhousie's Studley campus to describe the study and share the poster to collect responses.

Data analysis

After 8 days of data collection the survey was closed, and data analyzed to understand trends in answer responses and student perspectives. The analysis was conducted systematically with questions being sorted into the 5 categories previously listed and analyzed together. The survey responses comprised of both quantitative and qualitative data and thus different analysis techniques were utilized.

The quantitative results analysis was based on the type of variable (nominal, ordinal, interval, ratio). Categorical, likert-scale, and rating data were analyzed with frequency tables and/or central tendency (mode) calculations. Qualitative data was analyzed using content analysis, specifically coding trees. This was conducted by one researcher for each open-ended

question to limit the differences in code creations and allocations and then reviewed by the remaining researchers to remain uniform and avoid mismatched coding. This method allowed for major themes and trends to be visualized. Posteriori codes were used prior to analysis as code categories could not have been predicted due to the suggestion-based nature of the questions and lack of predictable responses. Once reviewed, categorical codes were created and through more thorough review more specific codes were used to break up and classify responses.

Method limitations

Due to the nature of the simple random sampling and its equal opportunities for all members of the sampled population to take part in the study, some demographic trends could be observed within the results. With all researchers being science students, bias relating to this could be observed due to peer sharing of the survey and professors selected to share the survey. Additional limitations presented due to the survey methodology. Because the respondents did not have the opportunity to ask clarifying questions to researchers about the questions being answered, respondents may have perceived questions differently which would have resulted in skewed results and analysis. Both of these limitations had the potential to skew results and thus lead to inaccurate representation of Dalhousie University's undergraduate students' perspective on green transportation on Studley campus. Further limitations resulted for the inaccessibility to enrolment statistics of Dalhousie University students studying at Studley campus. Due to this, all undergraduate students across all campuses were used for the calculation of the sample size, leading to an inflated number of respondents needed for statistical significance.

Results

Of the 42 respondents of our survey, the majority of respondent demographic were in 3rd year or above, with 6 users in 1st year (14.3%), 8 users in 2nd year (18.4%), 17 users in 3rd year (40.8%), and 11 users in 4th year (26.5%). 32 (76.2%) of the respondents were in the faculty of Science, with Arts and Social Science being the second largest faculty that respondents belong to, with 6 users (14.3%). Many respondents have sustainability experience at Dalhousie, with 26 (61.9%) of users having taken a few classes, and 5 (11.9%) of users in a Sustainability major. The majority of respondents resided in section D which represented the residential area between Coburg Street and Robie Street, North – Northwest of Dalhousie’s Studley campus (Figure 1).

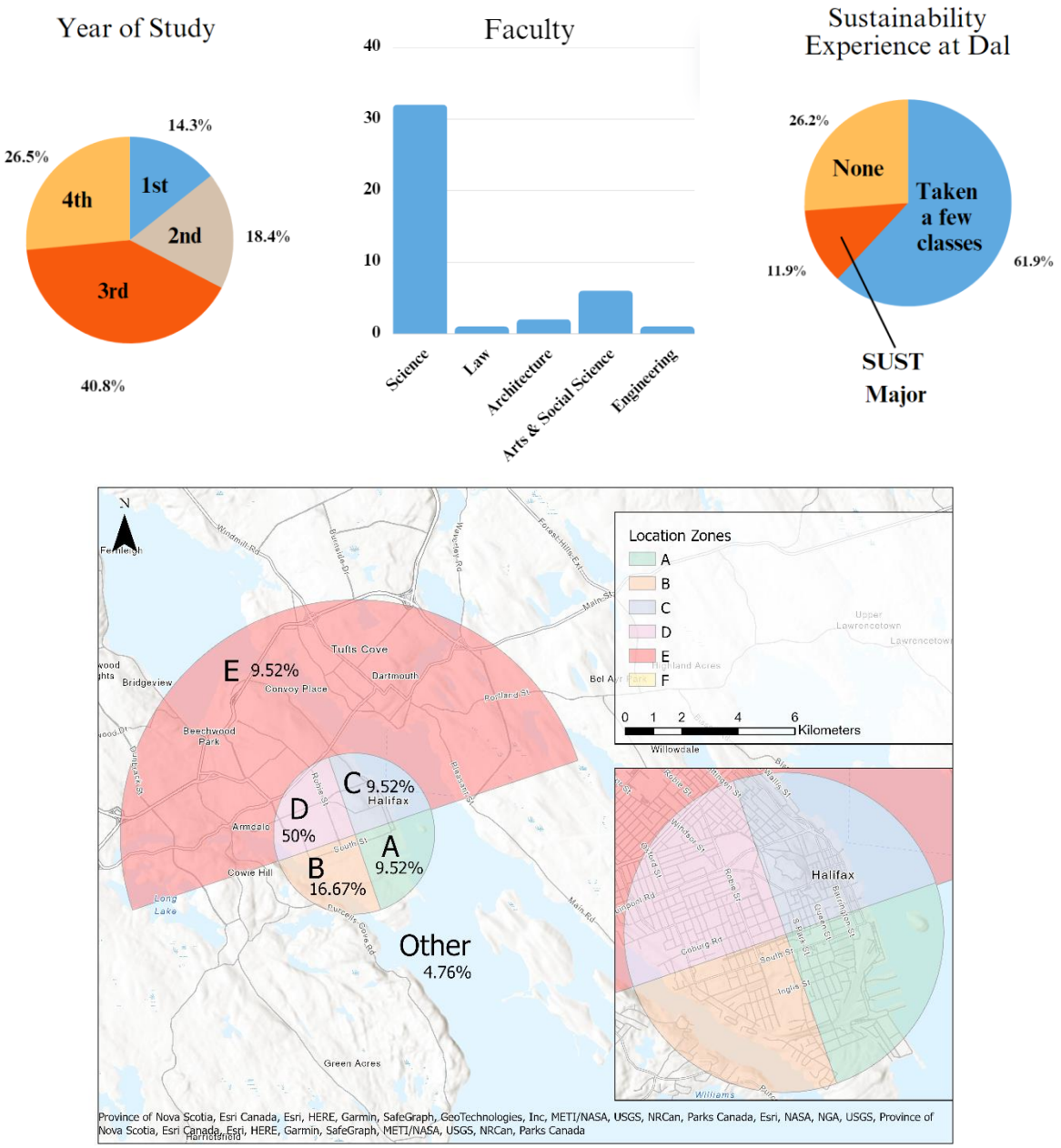


Figure 1. Four panel figure displaying two pie charts, one map and one bar graph related to demographic questions 2 (year of study), 3 (faculty), 5 (location of residence) and 19 (sustainability experience) from the survey (Appendix 1).

Transportation tendencies, accessibility, and ownership display that over half (27 users - 64.3%) of respondents walk to Dalhousie's Studley campus, with the second largest form of transportation being taking the bus to campus (10 users – 23.8%) (Table 1). Almost every user agreed that the public transit system in Halifax is very (29 users - 69%), or somewhat accessible (12 users - 28.6%), with only 1 user saying it is not accessible (Figure 2). 39 respondents

(92.9%) implied they do not own an electric transportation device, which is the vast majority (Figure 2).

Table 1. Frequency table illustrating the frequency of respondent's primary form of transportation to get to campus and back to their place of residence based on question 6 in the survey (Appendix 1).

Primary Form of Transportation	*Frequency*
Bussing	10 – 23.8%
Walking	27 – 64.3%
Driving	3 – 7.1%
Standard Biking	2 – 4.8%
Electric Biking	0
Electric Scooter	0
Skateboard	0
Other	0

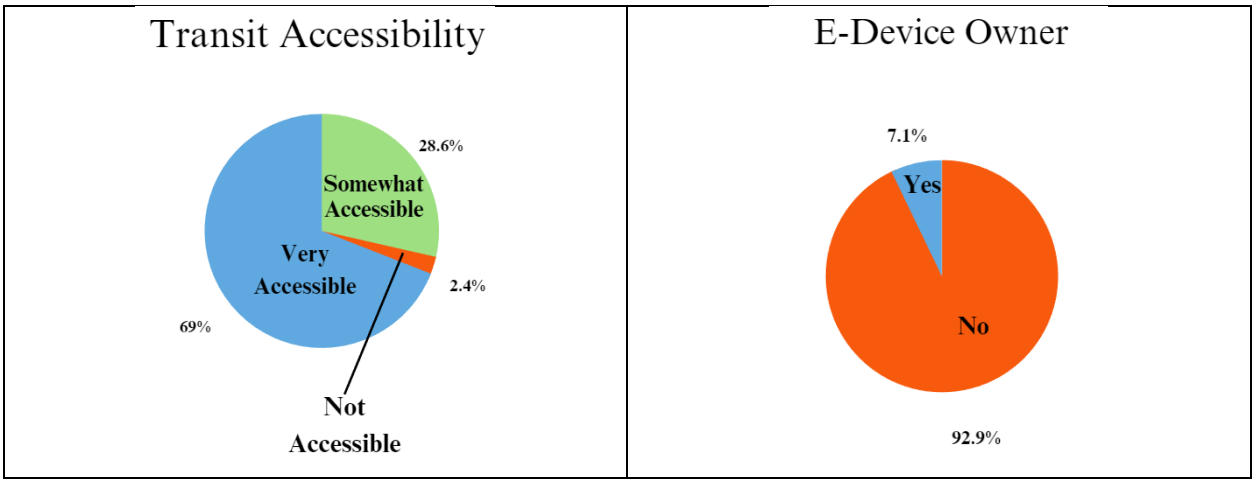


Figure 2. Pie charts depicting accessibility of the public transport system in Halifax for students to commute to Dalhousie's Studley campus and percentage of people who own an electric transportation device such as an electric scooter, electric bike, electric skateboard, etc., based on question 7 and16 in the survey (Appendix 1).

Questions 14 and 15 in the survey were based on interest of potential shared mobility programs in Halifax for commuting to Dalhousie. Users were more interested in a bike share program with 16 (38%) answering yes, 19 (45%) answering maybe, and only 4 (10%) of users not interested. People were less interested in an electric scooter share program, with 7 (17%) answering yes, 22 (52%) answering maybe, and 12 (29%) saying they are not interested (Figure 3).

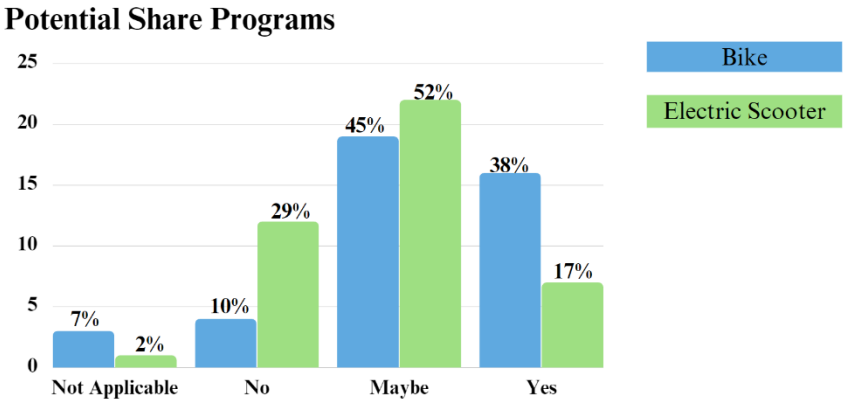


Figure 3. Bar graph depicting student perceptions on their interest in a potential electric scooter or bike share program. Based on questions 14 and 15 from the survey (Appendix 1).

Respondent awareness of Dalhousie free bike rentals and electric vehicle charging stations show that 22 users (52.4%) are aware of the free bike rentals, whereas 22 users (52.4%) are not aware of the electric vehicle charging stations at Dalhousie (Figure 4).

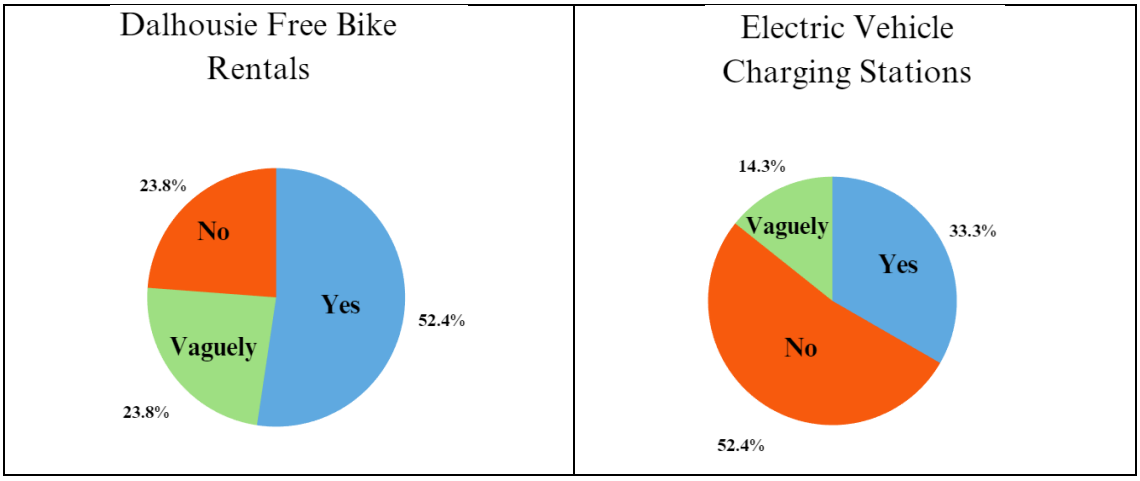


Figure 4. Two pie charts based on whether respondents are aware of Dalhousie's free bike rentals for students, and whether they knew Dalhousie has electric vehicle charging stations. Based on questions 12 and 13 from the survey (Appendix 1).

Regarding safety, over half of respondents agree or somewhat agree with the statement "I am interested in using less CO2 emitting methods of transportation such as bikes or scooters, but I am nervous about biking or scootering on the road due to the lack of bike lanes in Halifax, NS.". 13 users (31%) completely agree with the statement, and 14 users (33.3%) somewhat agree with this statement. Following the statement "I am interested in using methods of transportation which emit less CO2, but I do not have the monetary means to invest in these methods of transportation (i.e. a new bike/scooter/required protection gear) for these strategies", 12 users (28.6%) somewhat agree, 11 users (26.2%) do not agree nor disagree, and 10 users (23.8%) somewhat disagree with this statement (Figure 5).

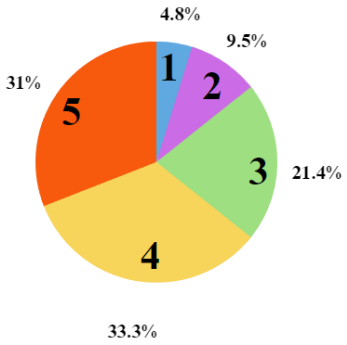
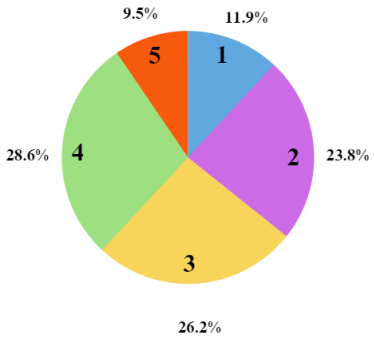
Nervous to Bike Due to Lack of Bike Lanes/Infrastructure	Monetary Limitations to Investing in Active Transport Devices
	
Mean – 3.76	**Mean – 3**
1 - I completely disagree with this statement	1 - I completely disagree with this statement
2 - I somewhat disagree with this statement	2 - I somewhat disagree with this statement
3 - I do not agree nor disagree with this statement	3 - I do not agree nor disagree with this statement
4 - I somewhat agree with this statement	4 - I somewhat agree with this statement
5 - I completely agree with this statement	5 - I completely agree with this statement

Figure 5. Two pie charts based on how well these statements apply to the respondent, based on questions 9 and 11 from the survey (Appendix 1).

Some themes were present in our open-ended question related to safety concerns. The two main safety concerns were the lack of, or unsafe infrastructure, with 43% of responses having similar concerns. The second main safety concern falls under the realm of interactions with other cyclists or vehicle drivers, with 50% of responses having concerns similar concerns (Figure 6).

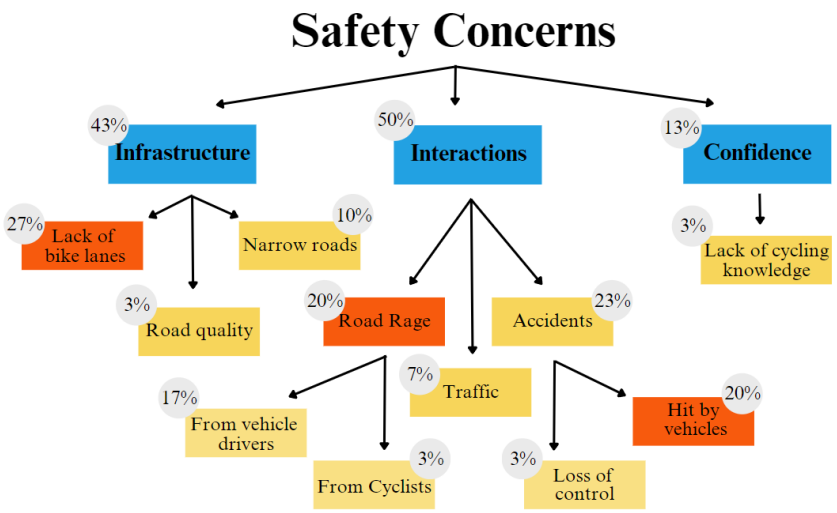


Figure 6. Coding tree based on qualitative data from the safety concerns of using active transportation (bike, scooter, e-scooter, skateboard) to commute to and from Dalhousie's Studly campus. Based on the open-ended response question 10 from the survey (Appendix 1). Colouration on the coding tree refers to blue: themes created, yellow: codes, and orange: codes of high frequency.

Regarding equipment storage, 13 users (31%) said we have enough, 10 users (23.8%) said we do not have enough, and the majority – 19 users (45.2%) were unsure, as they do not use the equipment storage. Of the 23.8% of users who said no, 27% of concerns were that it is equipment storage is location dependent. Some locations have plenty of storage, whereas some have none. 46% of users who answered no expressed another concern that there is no sheltered storage to protect from rust and damage from precipitation (Figure 7).

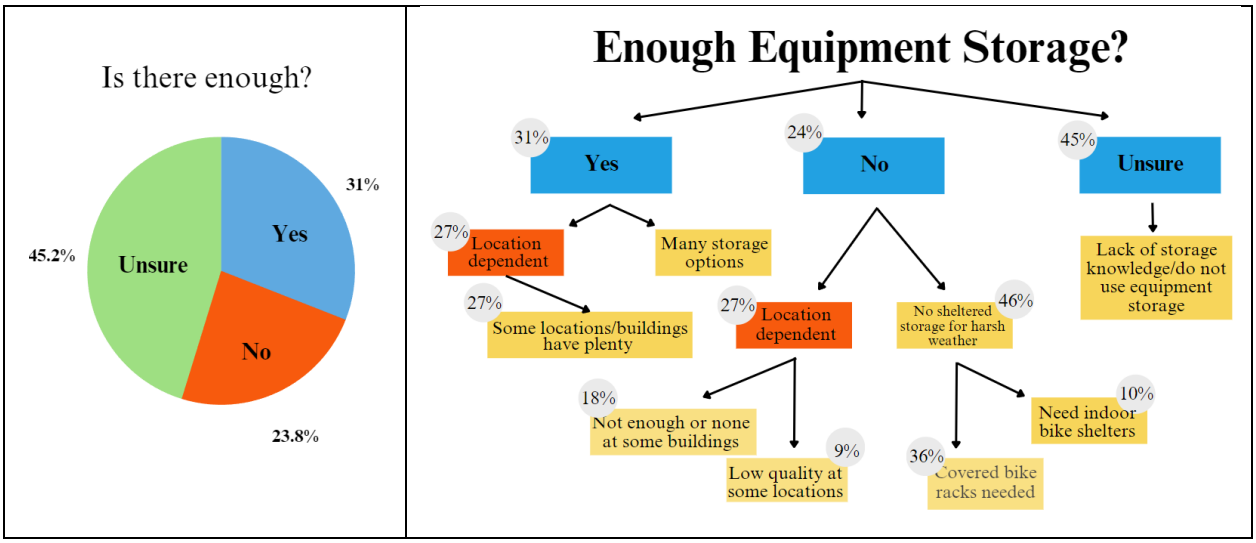


Figure 7. Pie chart and coding tree summarizing questions 17 and 18 (Appendix 1) related to equipment storage. Colouration on the coding tree refers to blue: themes created, yellow: codes, and orange: codes of high frequency.

Discussion

Key findings

The purpose of our study was to gain an understanding of undergraduate students' perceptions on the access, safety, and storage of active transportations methods to Dalhousie Studly campus, and back to their place of work or residence. There was a total of 42 respondents to our survey, with 40.8% being in their 3rd year of study and majority belonging to the science faculty (32/42) as displayed in Figure 1. 61.9% of respondents have taken a few sustainability classes which can be correlated to the skew in science major participants. Regarding public transit accessibility, 69% of respondents found public transit to be very accessible while 2.4% found transit not accessible as displayed in Figure 2. This is significant as approximately 2/3 of students found transit accessible. Table 1. depicts the primary form of transportation of students and their respective frequency of use. Walking and bussing were the most frequent modes of transportation with 64.3% using walking as their primary mode of transportation and 23.8% using buses. The vast majority of participants (92.9%) did not own an E-device and many participants were indecisive when it came to their perspective of potential share programs. As displayed in Figure 3, “Maybe” was the most selected answer for bike programs (45%) and electric scooter programs (52%). 52.4% of students had prior knowledge about Dalhousie’s free

bike rentals, and 52.4% had no prior knowledge of where electric vehicle charging stations were located on campus.

In regard to safety, most students were hesitant to bike to/from campus due to lack of bike lanes (27% of respondents) as displayed in Figure 6. Although “infrastructure” contained the highest individual safety concern (lack of bike lanes) it was the second largest overall safety concern with a sum of 43%, falling behind “interactions” with a sum of 50%. Interactions has more individual concerns when compared to the other large safety concerns (looking at the coding tree), and includes individual concerns such as road rage (20%) and accidents (23%) as seen in Figure 6. This data correlated well to Kellstedt et al, 2019 who found the majority of respondents when asked about green transportation safety concerns indicated lack of infostructure as their primary concern. This further implies that infrastructure is lacking in many areas for the use of green transportation.

Equipment storage yielded a mix of results, 31% of respondents saying there was enough storage on campus, 23.8% saying there was not enough storage, and 45.2% being unsure. When looking at Figure 7 (coding tree), we can see that location dependency is the most common factor when determining if there is enough equipment storage. We can also see that the majority of students were unaware of equipment storage in the first place as “unsure” received 45% of votes. Additionally, low knowledge of bike shop and electric charging initiatives were observed (Figure 4) as 23.8% of respondents were not familiar with the Dalhousie Bike Centre bike rentals and 52.4% of respondents were unfamiliar with the electric vehicle charging stations on Studley campus. With already implemented initiatives underway on Studley campus, this lack of knowledge from students on these strategies could be targeted through marketing to increase access to such services. Allocation of resources should be shifted to marketing already existing green transportation programs and further research on students' knowledge and use of these strategies should be monitored over time.

From this data we can interpret that the majority of students within the science faculty have taken a few classes in sustainability, which would be correlated towards their prior knowledge of sustainable transport on campus. This being said, 92.9% of students did not own a sustainable mode of transportation. We can attribute this to safety being a large portion as to why students were hesitant towards using green modes of transportation. The main concerns coming

from lack of infrastructure (proper bike lanes) and the fear of being in a collision. 2 out of every 3 students found transit on campus very accessible, which can be connected to walking and bussing being the most common modes of transportation. The large number of students unaware of equipment storage locations on campus can be attributed to walking and bussing, as there is no need to use these storage areas.

Study limitations

Sample size/bias - with a student body of 16,000 students we needed 378 viable respondents, however only 42 were recorded. Out of these 42 respondents, about 50% came from ENVS3502 which attributed to the skewed bias towards science majors. This bias can also be attributed to the skew in participants who have taken a few sustainability courses, as some of these majors may require sustainability courses to complete their degree.

Open-ended questions – some open-ended questions had a small response rate compared to the multiple-choice questions. For example, question 8 asking if students drive to school and their reason for driving, only had 7 respondents. This can be attributed to participants not wanting to write out a response, or the question may have not applied to them (if you do not have a car, you cannot answer question 8).

Student Voice – As students, we do not hold much authority on campus and our outreach is fairly limited. The survey was distributed in ways such as word of mouth or asking professors to share our project poster which contained a barcode linked to the survey with their classes. This likely contributed to lower than needed response rates.

Time the survey was available – The survey was open for 8 days (March 8th-16th, 2023) which could have added a bias towards the frequency of modes of transportation. March falls within the winter season so cars, buses, and short walking distances will be favourable compared to bikes, scooters, and other modes of sustainable transport that require and individual to brace the elements.

Context & Future research

A similar study was conducted at Virginia Tech where researchers looked at the perspectives and behavior of students towards e-scooters on campus (8). The researchers used

cross-sectional surveys to compare student perspectives pre and post implementation of an e-scooter system on campus (Kellstedt et al, 2019). They found that the majority of riders on campus were undergraduate students and that stated intention of using the system was greater than actual usage after the scooters were distributed (Kellstedt et al, 2019). Most students surveyed afterwards stated 2 things: 1. That the scooters were mainly used as a connector (class-scooter-parking lot/public transit) as opposed to being used as a direct commute to and from their place of work/residence. And 2. That the perspectives of non-riders shifted in a positive direction after the system was set in place due to initial concerns (such as accidents) occurring less often than anticipated (Kellstedt et al, 2019). The study expresses that public perception had changed in a positive way towards e-scooters on campus, and that it can be used as a pilot study to improve infrastructure such as proper bike lanes or separate spaces for e-scooters (Kellstedt et al, 2019).

Future research should be put into collecting not only students' perspectives of sustainable transport on campus, but the public perspectives as well. If the public can be convinced that these are positive alternative modes of transport, then there will be more support for change in things like proper bike lanes. This will encourage more people to use these sustainable modes of transport, as safety concerns regarding improper lanes and accident occurrences should go down as well (as these were the main concerns in our results). This will then help the city as a whole become more sustainable through less pollution from vehicles such as cars.

Having a high accessibility and frequency of public transport use failed to support our hypothesis as we expected more students to use non-sustainable modes of transportation such as cars.

Conclusion

The survey's findings indicate that the interviewees mostly did not utilize e-bikes and e-scooters as their mode of transportation and that most of them thought that the present modes of transportation could satisfy their travel needs. One of the main points is that most people believe that bike lanes are not perfect, and that e-bike and e-scooter safety is not assured, which also contributes to a decline in utilization. According to the statistics, we can make some

recommendations, such as creating bike lanes to boost the likelihood of utilizing bicycles and making more people aware of the location and availability of free bike rentals on campus.

Literature cited

Buehler, R., Broaddus, A., Sweeny, T., Zhang, W., White, E., Mollenhauer, M. (2021). Changes in Travel Behavior, Attitudes, and Preferences among E-Scooter Riders and Nonriders: First Look at Results from Pre and Post E-Scooter System Launch Surveys at Virginia Tech. *SAGE journals*, 2675(9), 335-345. https://journals.sagepub.com/doi/pdf/10.1177/03611981211002213

Dalhousie University. (2021). Facts, Figures, and Rankings. Dalhousie University. https://www.dal.ca/about-dal/dal-at-a-glance.html

Kellstedt, D., Spengler, J. O., Bradley, K., Maddock, J.E. (2019). Evaluation of free-floating bike-share on a university campus using a multi-method approach. *Science Direct,* 16(100981). https://doi.org/10.1016/j.pmedr.2019.100981

Geurrieri, M., Gennusa, M.L., Peri, G., Rizzo, G., Scaccianoce, G. (2019). University campuses as small-scale models of cities: Quantitative assessment of a low carbon transition path. *Renewable Sustainable Energy Rev.* 113:109263. https://doi.org/10.1016/j.rser.2019.109263

Intergovermental Panel on Climate Change (IPCC). (2023). *Synthesis report of the IPCC assessment report (AR6).* https://report.ipcc.ch/ar6syr/pdf/IPCC_AR6_SYR_LongerReport.pdf

Jones, B., Elliot, R.J.R., Nguyen-Tien, V. (2020). The EV revolution: The road ahead for critical raw materials demand. *Appl Energy.* 280: 115072. . https://dio.org/10.1016/j.apenergy.2020.115072

KPMG. (2020, June 20). *The road to adoption: building EV infrastructure and smart.* KPMG. https://kpmg.com/ca/en/home/insights/2022/06/the-road-to-adoption-building-ev-infrastructure.html

Li, H.R. (2016). Study on green transportation system of international metropolises. *Provedia Eng.* 137, 762-771. https://doi.org/10.1016/j.proeng.2016.01.314

Litterman, B. (2020, September 21). Wildfires have devastated my city. CNN. https://www.cnn.com/2020/09/21/perspectives/wildfires-climate-change-carbon-tax/

Moosavi, S. M. H., Ma, Z., Armaghani, D. J., Aghaabbasi, M., Ganggayah, M. D., Wah, Y. C., & Ulrikh, D. V. (2022). Understanding and predicting the usage of shared electric scooter services on university campuses. *Applied Sciences (Switzerland),* 12(18) doi:10.3390/app12189392

Our World in Data. (2020). *Cars, planes, trains: where do CO2 emissions from transport come from?* https://ourworldindata.org/co2-emissions-from-transport

Statistics Canada. (2022, February 9). *Canada's large urban centres continue to grow and spread.* https://www150.statcan.gc.ca/n1/daily-quotidien/220209/dq220209b-eng.htm

Appendix 1: Survey

Q.1 Do you consent to taking this survey?

- I Consent
- I do not consent

Q.2 What is your year of study?

- 1st year undergraduate degree
- 2nd year undergraduate degree
- 3rd year undergraduate degree
- 4+ year undergraduate degree
- Other

Q.3 What faculty houses your program of study? (for double majors or other special cases pick your primary major's faculty)

- Agriculture
- Architecture and Planning
- Arts and Social Science
- Computer Science
- Dentistry
- Engineering
- Health
- Law
- Management
- Medicine
- Open Learning & Career Development
- Science
- Other

Q.4 What Dalhousie Campus currently hosts the majority of your classes?

- Studley Campus

- Sexton Campus

- Carleton Campus

- Truro Campus

Q.5 According to the map below, in which area do you currently live? (Figure 1)

- A

- B

- C

- D

- E

- Other

Q.6 What form of transportation do you use the majority of the time to get to campus and back to your place of residence?

- Driving

- Bussing

- Walking

- Standard Biking

- Electric Biking

- Electric Scooter

- Skateboard

- Other

Q.7 Do you own an electric transportation device such as an electric scooter, electric bike, electric skateboard, etc.?

- Yes

- No

- Other

Q.8 If you drive to school, what are the reasons that you choose this method over a bike/bus/scooter etc.?

- (open ended)

Q.9 How well does this statement apply to you?

"I am interested in using less CO2 emitting methods of transportation such as bikes or scooters, but I am nervous about biking or scootering on the road due to the lack of bike lanes in Halifax, NS."

- 1 - I completely disagree with this statement

- 2 - I somewhat disagree with this statement

- 3 - I do not agree nor disagree with this statement

- 4 - I somewhat agree with this statement

- 5 - I completely agree with this statement

Q.10 What are your safety concerns (if any) related to using active transportation (i.e. bikes, scooters) for commuting to and from Dalhousie's Studley campus?

- (Open ended)

Q.11 How well does this statement apply to you?

"I am interested in using methods of transportation which emit less CO2, but I do not have the monetary means to invest in these methods of transportation (i.e. a new bike/scooter/required protection gear) for these strategies"

- 1 - I completely disagree with this statement

- 2 - I somewhat disagree with this statement

- 3 - I do not agree nor disagree with this statement

- 4 - I somewhat agree with this statement

- 5 - I completely agree with this statement

Q.12 Are you aware that Dalhousie has a bike shop and free bike rentals on Studley campus?

- Yes

- No

- Vaguely

- Prefer not to answer

Q.13 Are you aware that Dalhousie's Studley campus has electric car charging stations?

- Yes

- No

- Vaguely

- Prefer not to answer

Q.14 Would you be interested in using a city-wide pay per use (duration) **electric scooter** share program if you could leave the device on campus when you arrive (Studley campus specifically)?

- Yes

- No

- Vaguely

- Not Applicable

Q.15 Would you be interested in using a city-wide pay per use (duration) **bike** share program if you could leave the device on campus when you arrive (Studley campus specifically)?

- Yes

- No

- Vaguely

- Not Applicable

Q.16 How accessible is the public transit system for you to commute to and from Dalhousie University's Studley campus?

- Easily accessible

- Somewhat Accessible

- Not Accessible

- Prefer not to answer

Q.17 Do you feel there is enough storage for active transportation equipment (bikes, scooters etc.) on Dalhousie Studley campus?

- Yes

- No

- Unsure

- Prefer not to answer

Q.18 If you answered no to the above question (Q. 17) how could the storage system be improved?

- (open ended)

Q.19 What has been your experience with taking sustainability related courses at Dalhousie?

- No experience

- I have taken few classes related to sustainability

- Completing a sustainability major

- Prefer not to answer

Appendix 2: Survey Poster