

**Dalhousie University student perceptions regarding the current state of Studley-campus
study spaces**

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Executive Summary

Our research question was: What is the current perception of Dalhousie University students regarding the built environment of study spaces on Studley campus? To test our research question, we developed a 10-question survey focusing on students preferences and perceptions of the built environment. This allowed us to deepen our knowledge of student understanding of their relationship to the built environment, as well as gain insight into the strengths and shortcomings of study spaces on Dalhousie's Studley campus.

Our results indicate that most students prefer studying at either the Killam Library or the Wallace McCain Learning Commons. The majority of students surveyed choose their study space based upon: a) low noise; b) available seating; and c) access to power outlets; with less than 50% considering natural lighting. When asked what could be improved about Dalhousie's Studley Campus Study spaces, the top three factors were: a) available seating; b) natural light; and c) availability of power outlets. Our analysis also found that the majority of students feel that their productivity, anxiety, and stress are greatly influenced by the study spaces they use.

Overall, the results of our survey offered several key findings. First, the factors that the majority of students consider when choosing a study space do not directly reflect the factors deemed most important in the literature. This tells us that students may not be choosing study spaces that will best support their productivity and mental wellbeing. Second, students believe that Dalhousie's Studley campus is lacking in several of the factors deemed most important by the literature for supporting productivity and mental-wellbeing. We therefore must ask if students do not prioritize these factors because they do not care about them, do not recognize their benefits, or because they do not feel they can be met given the current facilities.

These findings can be used to aid Dalhousie University in improving current study spaces, as well as the creation of new ones. Dalhousie University should target the most-popular study spaces, including the Killam Library and Wallace McCain Learning Commons for improvements, and should focus on improving the factors deemed important by students and found in need of improvement, including available seating, access to power outlets, low noise, and increased natural light. By not only considering the literature, but also the needs and concerns of current Dalhousie students, the university will be more able to prioritize funds and resources for the built-environment factors that matter most.

Introduction

Project definition and importance

In this paper, we outline and explore the relationship between students and the built environment of Dalhousie University's Studley Campus study spaces. Founded upon existing literature, our research question was: What is the current perception of Dalhousie University students regarding the built environment of study spaces on Studley campus? Where the built environment is defined as the man-made surroundings used by humans (including buildings, furniture, and decor).

Students make up the majority of individuals on any post-secondary campus, and using non-classroom hours for studying is a major component of university. Previous research suggests that improvements to study spaces can decrease student stress and anxiety levels, increase their productivity and academic achievement, and provide them with a greater sense of community on campus (Hipp et al., 2016; Yang, Becerik-Gerber, & Mino, 2013; Banning et al., 2010). By collecting data on the most-preferred study spaces on Dalhousie's Studley campus, including which built-environment factors are considered when choosing a study area, and which of these factors could be improved, we have gained invaluable insight into student study space preferences. This information can be used by university personnel to create targeted improvements to on-campus study spaces that focus on the most in-demand study areas and factors of their built environment.

Dalhousie University has committed to creating a more sustainable campus, with long-term goals specified by the Office of Sustainability that will help the university move towards the creation of what is commonly known as a 'green campus' (defined as "an institution for higher learning which works towards improving energy efficiency, protecting environmental resources, creating healthy living and learning environments, and achieving an overall improvement in the environment through educating about sustainability"; U.S Green Building Council, 2010). Two of these goals are: 1) to increase health/social characteristics of the campus overall, and 2) attract other people to the university due to this sustainability (Dalhousie University, 2017). The results of our study can help Dalhousie University create a healthy learning environment in on-campus study spaces, and can be applied to other post-secondary campuses looking to create a successful green campus.

Who we are

All researchers of this project are Dalhousie undergraduate students. As such, we have come to recognize and understand how the on-campus environment has the power to shape university experiences. We have dealt with stress and anxiety resulting from academic demands; we have experienced productive study sessions and suffered through ones that went nowhere; and we also realize how our connections with others on campus can be influenced by our surroundings.

Our research was motivated by a strong desire to inform targeted improvements to on-campus study spaces that would promote mental wellbeing, productivity, and a sense of community - a set of interconnected issues that we have all found highly relevant in university life. We chose to focus our research on the built environment after multiple discussions, between ourselves and with other students, regarding the current state of Studley campus study areas and how they can be improved. Our goal was to determine Dalhousie student's feelings about this issue, so we could help create an improvement plan for on-campus study spaces that would provide the greatest benefit for the most students.

Background and rationale

University poses a difficult time in many individuals' lives, as students face additional academic-related stressors on top of common stress- and anxiety-causing factors, such as work, family, friends and significant life changes (CMHA, 2014). Common sources of stress for students include examinations, grades, heavy workloads, and having to compete for relevant work and volunteer positions (Goff, 2011). High stress and anxiety in students has been found to lead to increased drinking, absenteeism, and dropouts, reduced ability to meet deadlines and/or academic goals, and lower academic achievement (Armeli et al., 2011; Cook, 2007; Felsten & Wilcox, 1992; Stallman, 2008).

These feelings of academically induced stress and anxiety are not limited to a select few students. The American College Health Association (2016) found that within the past 12 months (leading up to the study), 89.5% of Canadian post-secondary students felt overwhelmed by academic demands, 64.5% felt overwhelmed with anxiety, and 13% had even considered suicide. Additionally, the study found that 46.2% of students experience above-average stress levels, with 14.4% experiencing tremendous stress levels. Other notable results from the same study include the 58.1% of students who felt their academics had been "traumatic or very difficult to handle", and academia was the top stressor in their lives.

Stress and anxiety in students can also be affected by their "productivity", which is often equated with academic achievement. Academic performance increases with lower levels of stress and anxiety, and stress and anxiety increase with lower academic achievement (Stallman, 2008). Other influences on productivity in postsecondary settings include higher self-efficacy, student-learning and teacher-teaching styles, and collaboration with peers and mentors (Lee & Bozeman, 2005; Visser et al., 2006; Zimmerman, Bandura, & Martinez-Pons, 1992). Beyond impacting stress and anxiety, productivity and academic performance are valued for furthering academic studies or obtaining employment upon graduation.

There are many ways for students to deal with stress and anxiety, one of which is through feeling like they are part of a community. Communities are commonly defined as groups of individuals with something in common. In postsecondary settings, these commonalities are often the pursuit of higher education, research, and innovation (among others). A sense of community is based upon membership, integration, needs fulfilment, influence, and emotional/spiritual connections (McMillan & Chavis, 1986). A greater sense of community on campus is influenced by: a focus on learning, openness, and diversity; on-campus services and support; higher levels of student involvement; and interactions between peers and teachers (Boyer, 1990; Pascarella & Terenzini, 1979).

A strong sense of on-campus community has been found to result in high academic achievement and fewer student dropouts (Kuh et al., 2008; Palmer, Maramba & Dancy, 2011). It has also been shown to facilitate collaboration and inclusion, promote diversity, create feelings of caring and responsibility towards the campus and its occupants, and support academic achievements (Boyer, 1990). While the attainment of a sense of community on campus seems largely social, it can also be influenced by the built environment, as can productivity, stress, and anxiety.

Impact of the built environment

There has been much research regarding the relationship that the built environment has with stress and anxiety. Students who spend more time in spaces with a large amount of "greenness" (e.g. plants) have a higher perceived quality of life, including reduced stress and anxiety (Hipp et al., 2016). University students in stress-filled and/or overwhelming educational settings have been found to prefer spending time in nature or areas containing

natural elements, such as water ponds or fountains, plants, and windows with outdoor views of nature (Windhorst & Williams, 2016). Simply looking at nature through a window has been found to decrease stress in students (Kaplan, 2001).

Productivity has been shown to be influenced by many aspects of the built environment, both natural and constructed. Increased natural light has been found to have a positive effect on workplace productivity and performance, as well as learning rate (Boubekri et al., 2014; Edwards, & Torcellini, 2002; Hua, Oswald, & Yang, 2011). Similarly, warmer temperatures, good ventilation, and low noise have been shown to improve academic achievement and attendance rates (Yang, Becerik-Gerber, & Mino, 2013; Mak & Lui, 2012). While these factors may cost more to improve (in terms of time and money), there are simpler factors that can affect productivity as well. A greater number of indoor plants in a workplace has been found to increase employees perceived productivity (Larsen et al., 1998). Ergonomic furniture and the comfort of seating has been found to affect typing speeds and student concentration, two factors essential to learning in modern-day academic settings (Haynes & Williams, 2008; Yang, Becerik-Gerber, and Mino, 2013; Wollin, 1981). Even the colour of wall paint has been found to improve student test scores (Wollin, 1981).

Overall, integration of 'natural' aspects into the built environment can have a positive influence on both individual studying and the creation of community. Areas containing water elements, plants, and clear views of the outdoors create spaces where students and university personnel tend to gather (Joye, 2007). Quiet, natural environments also establish valued spaces for individual work (Banning et al., 2010). Spaces with open areas as well as ample seating and table space have been found to be valued by students because they facilitate interaction with peers, professors, and mentors (Banning et al., 2010; Harrington, 2014). Such interactions are an integral part of creating a sense of on-campus community. Softer lighting, bright wall paint, and comfortable seating are also cited as promoting better student-mentor relationships (Wollin, 1981). Although students have been found to value privacy and seclusion when studying, such spaces are often sources of pride and community connection resulting from academic success and aesthetic beauty (Banning et al., 2010; Harrington, 2014). This indicates that both group and individual study spaces are attached to the feeling of on-campus community, which can ultimately lead to reduced stress and anxiety levels, and thus, increased productivity.

Significance in the university setting

Given the high prevalence and far-reaching consequences of stress and anxiety in postsecondary settings, it is evident that universities should strive to create an environment that reduces these negative emotional responses to the greatest degree possible. Environments that foster a sense of community and promote productivity and academic achievement could result in lower stress and anxiety due to the emotional support of communities and the association between greater academic achievement and lower stress and anxiety. An important environment to target is those of on-campus study spaces, as these are locations in which students spend a great deal of time working towards their academic goals, and thus are locations where students are most likely to experience stress and anxiety, and are most in need of a strong sense of community and productivity.

Universities are located in a variety of settings, such as small towns, to large urban centres where the built environment dominates. As research has shown that natural and manmade features can be incorporated into the built environment in ways that affect stress, anxiety, productivity, and sense of community, changing the built environment may be a viable way to improve these factors at universities where the urban environment dominates.

Dalhousie University's Studley campus is situated in downtown Halifax, Nova Scotia. As the university is surrounded by urban environments, it cannot be assumed that students are given adequate exposure to nature while on campus. It also cannot be assumed that students are currently satisfied with the built environment of on-campus study spaces, or that they do not perceive the environment of their study space as having an influence on their stress, anxiety, productivity, or sense of community.

Studley Campus is home to a wide variety of study spaces, each with a distinct built environment. Our research aimed to determine student perceptions of the built environment of these study spaces. This included developing an understanding of which factors are important to them when choosing a study space, which need to be improved, and how strongly study spaces influence their stress, anxiety, productivity, and sense of community. By highlighting the factors students value, as well as those in need of improvement, the university can better target the improvement of current study spaces and the creation of new ones. In making targeted improvements to on-campus study spaces based on student opinions, students will not only be more satisfied with these areas, but may also have lower levels of stress and anxiety, greater productivity, and a better sense of community on campus.

Our research has implications for university policies and decisions, whereby student opinions can have a greater influence on decision-making about the design of student-used campus spaces. This project can serve as inspiration and/or guidance regarding the approach to improving the built environment of other areas on the many Dalhousie campuses, and other university campuses as well. Our study can also be used to complement future studies that choose to focus on the social, cultural, or other environments of study spaces. Finally, the results of our research can be used to help Dalhousie achieve two of its sustainability goals by improving health and social wellbeing on campus, and attracting people to visit it.

Methods

Questionnaire

Data was gathered using a pencil-and-paper questionnaire consisting of ten close-ended questions (Appendix A). We chose this method (as opposed to other potential sampling structures such as interviews), as it was the best fit considering the nature of our research question. The aim of our study was to determine *what* student perceptions of on-campus study spaces are, and not *why* students have these particular opinions. The exploratory nature of this research allowed us to sample and process a larger number of respondents than would have been possible had we taken a more causal approach to understanding student perceptions of study spaces. This is not to say that exploring the causes of student perceptions of study spaces is not worth researching, but that due to our time and resource constraints, we were unable to do this research meaningfully (Atchison & Palys, 2013).

The questionnaire consisted of nine close-ended questions (one dichotomous, two categorical, two multiple-response, and four rating scales) as well as one open-ended question (Atchison & Palys, 2013). The questions were structured in a conversational style and were arranged to become more narrow in theme as the survey continued. This made the survey more attractive and comprehensive for respondents, while avoiding potential answer bias due to the content of the previous questions.

The survey collected information on degree program and year of study, as well as the location where the individual was sampled, to determine how heterogeneous the sample was. This demographic information was not used to make comparisons between grouping variables, as we were interested in determining the Dalhousie student perception overall.

We utilized close-ended questions for several reasons: 1) it allowed responses to focus on aspects of the built environment, 2) large amounts of data could be collected and processed in a short period of time, 3) it reduced the likelihood of insufficient and joke answers, and 4) the survey could be completed over a short period of time, reducing barriers to participation (Atchison & Palys, 2013). Including one open-ended question gave respondents the opportunity to address any additional information they deemed important regarding on-campus study spaces, which provided us with insights we did not initially consider.

The first two questions addressed both the primary location of studying, as well as overall hours spent studying. These two questions helped give context regarding the relevance and importance of our research and whether improvements to on-campus study spaces would benefit a large proportion of students.

The third question asked which building on Studley campus (of ten possible choices) the respondent most preferred to study in. However, some students did end up indicating more than one building, and all answers were recorded. This gave insight as to which buildings on campus are most popular for studying, and thus which buildings should be the focus for improvements. The fourth question asked respondents to indicate all built-environment factors (of a possible 14) that they consider when choosing a study space, which allowed us to determine which factors were most important to students. The fifth question asked students to indicate which of those same 14 factors could be improved on Studley campus, and was used to indicate what improvements should be targeted.

The sixth, seventh, eighth, and ninth questions asked students to indicate, on a scale of 1 to 5 (1 = not at all, 5 = very much), how the built environment of on-campus study spaces influences their anxiety, stress, productivity, and sense of community on campus. ‘Sense of community on campus’ was defined as “ability to connect/interact with your peers, professors/mentors, and/or the rest of the Dalhousie community” to clarify the concept for respondents. These questions were used to determine if respondents perceive the built environment as having an impact on these aspects of their life.

The final question was open-ended, asking for additional information the respondent deemed relevant regarding the built environment of study spaces. This information was used to gain additional insight into factors that were omitted throughout the rest of the survey.

Sampling

There were 124 Dalhousie students sampled in total, which resulted in a confidence level between 90 and 95%. This sample size was large enough to give an adequate representation of varying student opinions but was also small enough that it could be obtained within the given time constraints. Students were sampled using a criterion sampling format, whereby the only criterion was that the respondent must be an undergraduate or graduate student currently attending Dalhousie University. This criterion was critical to the study, as the research project was focused on the perception of students regarding study spaces on Dalhousie Studley campus, to which only Dalhousie students have access.

Students were surveyed across 8 locations on Studley campus, including the Killam Library Atrium, McCain Arts and Social Sciences Building, Life Sciences Center (LSC), Student Union Building (SUB), Rowe Management Building, Mona Campbell Building, an on-campus residence building, and the Weldon Law Building (Appendix 2, Figure B). These locations were used for sampling because they host multiple classes from various degree programs, which allowed for the obtainment of a more heterogeneous sample. All of the sample sites were located on Studley campus, which ensured that we were sampling Dalhousie students who spend time on Studley campus (as opposed to Sexton or Carleton

campus). When sampling within the buildings mentioned, areas used for studying were avoided in order to prevent skewing the data by surveying a collection of students who were currently within their preferred study space. Students were sampled at various times over multiple days, as class days and times tend to cluster dependent upon year and program of study, allowing for a more diverse sample population.

Sampling was done by approaching individuals on the Dalhousie campus and asking them if they were a Dalhousie student. If they answered yes, they were then asked if they would be willing to fill out a brief survey regarding study spaces on Studley campus. The purpose of the project was then explained to them. Respondents were told to omit any identifying information, such as names or student numbers, from the survey. They were also informed that by completing and returning the survey they were giving implicit consent to have their answers used for the purpose we described. However, they were allowed to withdraw that consent at any point. To maintain confidentiality, all completed surveys were placed in opaque envelopes that were opened once all sampling was completed.

Data analysis

All of the collected data was inputted into an Excel document using numerical coding, where '1' indicated a response, and '0' indicated no response. Using the total responses in favour of each potential answer, a frequency analysis was done for each question and a frequency graph was produced, indicating the proportion of students selecting each potential response. Proportions were utilized (vs. actual number counts) as the information was being generalized to the Dalhousie student body as a whole. When examining the frequency graphs for trends in the data, higher proportions were taken as indicative of a greater consensus among students. Due to the nominal and ordinal nature of our data, further in-depth statistical analyses could not be performed (including calculation of standard deviation, t-tests, Chi-square tests, etc.).

The open-ended question was analyzed using deductive coding based on adjectives used to describe on-campus study spaces. This information was organized based on the 'purpose' of the comment and individually coded to determine areas of concern. The 'purpose' was broken down into: potential improvements, specific complaints, positive comments, and direct reference to specific study spaces. Multiple comments that were similar were taken to be indicative of important factors, however, all comments were read and considered in the context of the other data collected.

Reliability, validity and trustworthiness

Reliability, which is generally considered synonymous with consistency, is unlikely to have been a large issue in our research. Given the close-ended nature of the questions, which had limited, pre-determined answers, as well as clearly defined terms such as 'built environment' or 'preferred study location', it is unlikely that respondents misinterpreted or answered questions incorrectly. However, 'anxiety', 'stress', and 'productivity' were not defined operationally on the questionnaire, which may have affected respondent answers in questions 6, 7, and 8, as respondents may have some variation in defining each term. However, due to the commonality of these terms, it is likely respondents define them in a similar manner.

Validity, which assesses whether operational definitions serve their intended purpose, is also unlikely to be a significant issue. The answer choices for questions 4 and 5 are adequate indicators to represent "built environment" as they are man-made surroundings used

by humans, which is the common definition for “built environment”. None of the indicators were related to aspects we did not intend to measure, such as the social environment.

The methods used were trustworthy in that the questionnaire only required the respondent to be able to read and comprehend English, and provide truthful responses. Considering that English language proficiency is a requirement for admittance to Dalhousie University, we were not overly concerned about potential language barriers (although we acknowledge the slight chance that they may have been present, due to the diversity of Dalhousie students). Due to the close-ended nature of the questionnaire, there was little opportunity for ‘joke’ answers, so there was low risk that any respondents did not answer questions truthfully. However, as with any questionnaire, there was no way of knowing if a respondent provided truthful answers.

Limitations and delimitations

Factors that were out of our control (otherwise known as limitations) included our sample size, which was limited by time/resource constraints. The degree of seriousness with which respondents took the survey may also have been a limitation, given that we had no way to discern which respondents took the survey seriously and which (if any) did not. Additionally, due to the close-ended nature of our questions, we could not understand the reasons behind respondent choices (e.g. we could not know if they value comfortable seating because it helps them relax while studying or because it helps them stay focused).

A large limitation resulting from our research question (otherwise known as a delimitation), is that we only examined the aspects of the built environment of study spaces and did not consider the social environment or other important factors involved in creating an ideal study space. Due to time/resource constraints, we were unable to collect data on, and make comparisons between, potential grouping variables and therefore could not ascertain whether there were differences among student preferences/perceptions based on degree program, gender identity, culture, or so on.

Results

Time spent studying on Studley campus

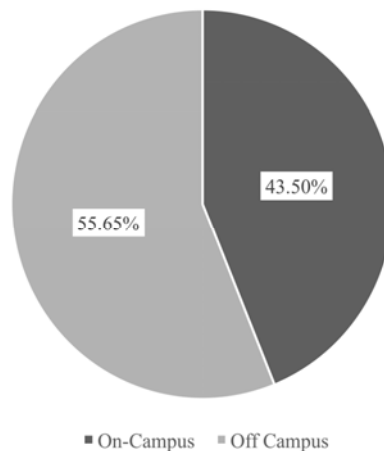


Figure 1: Proportion of Dalhousie students who spend more non-class hours studying on-campus or off campus.

A greater proportion of students spend the majority of their non-classroom study hours off Studley campus versus on campus. Specifically, 12.15% more students responded that they spent more time studying off campus compared to on campus (Figure 1).

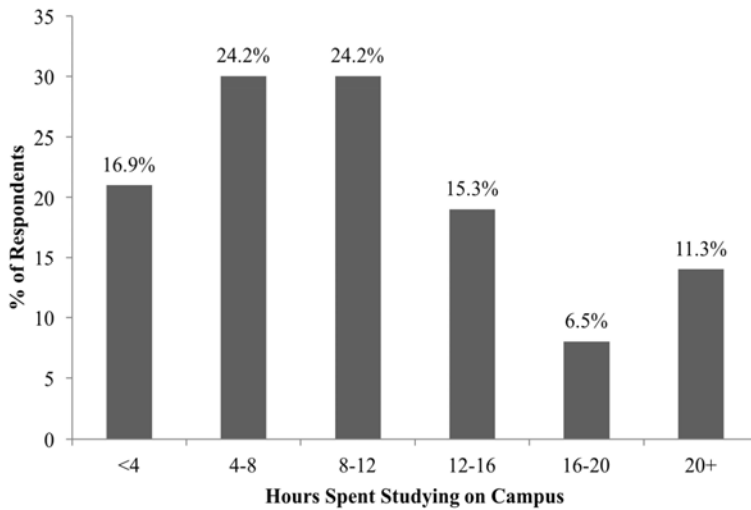


Figure 2: Average number of non-class hours per week Dalhousie students spend studying on Studley campus.

The largest proportion of students (24.2%) indicated spending on average between 4 to 8 or 8 to 12 hours studying on-campus per week (Figure 2). The smallest proportion of students indicated spending 16-20 hours studying on campus.

Preferred study location

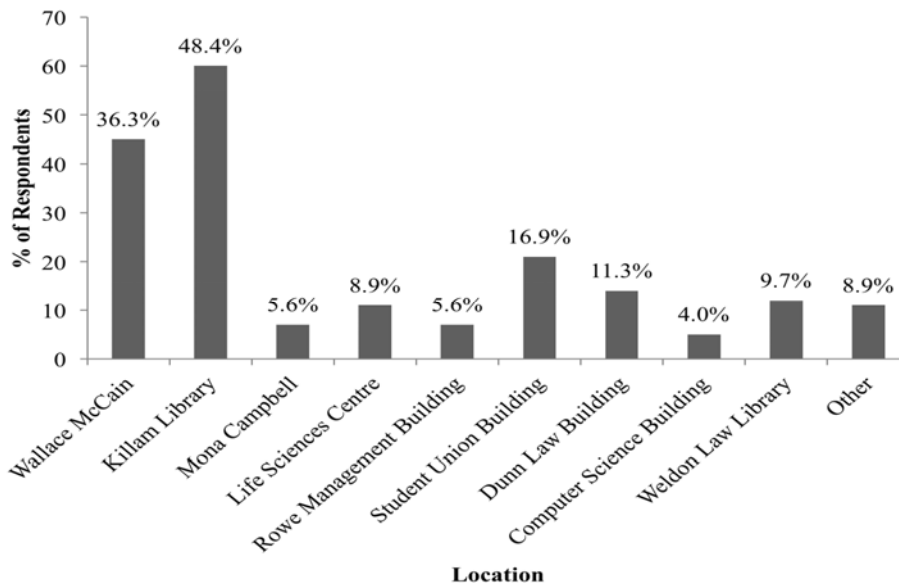


Figure 3: Proportion of Dalhousie students who prefer each study location on Studley campus. *Note: proportions do not add to 100%, as some students indicated more than one preference.

The Killam Library was the preferred study location for the greatest proportion of students (48.4%), followed by the Wallace McCain Learning Commons (WMLC) (36.3%) (Figure 3). The next most preferred study space, which saw a 20% drop in support compared to the WMLC, was the Student Union Building (SUB). As such, the Killam Library and WMLC were preferred by a notably higher proportion of students. Among the “other” locations specified by students, the Collaborative Health Education Building (which is not located on Studley campus) was the most common (36% of ‘other’, or 3.2% of total responses).

Built-environment factors considered and needing improvement

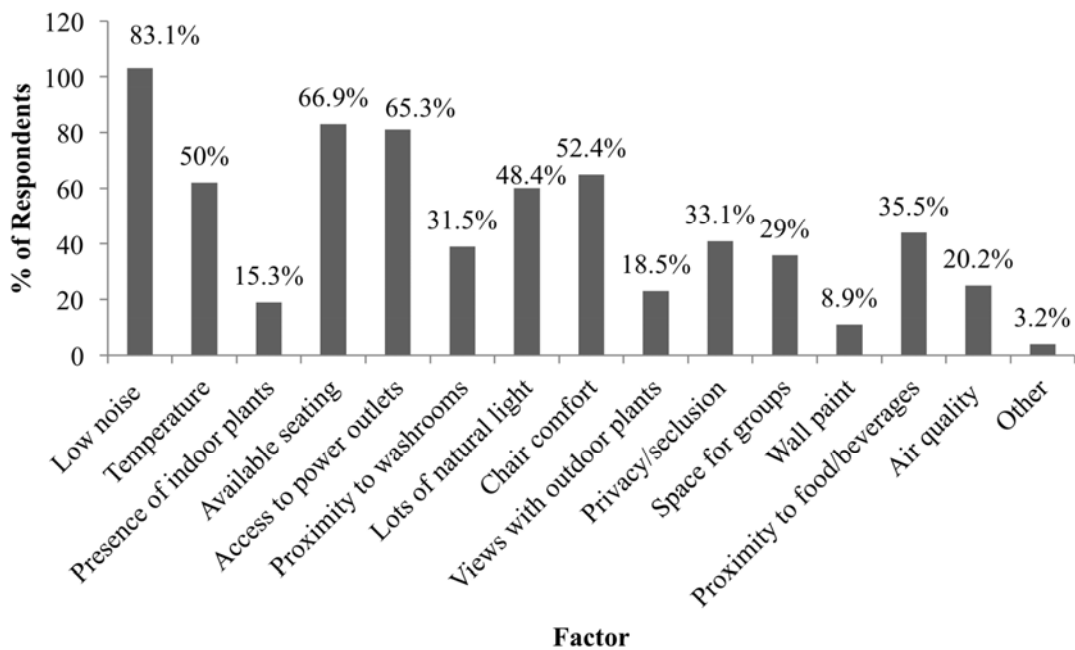


Figure 4: Proportion of Dalhousie students who consider each given factor of the built environment when choosing a study space on Studley campus. *Note: proportions do not total to 100% because multiple responses were allowed.

By a margin of 16.2%, ‘Low noise’ was the factor deemed important when choosing a study space by the highest proportion of students (Figure 4). ‘Available seating’ (66.9%) and ‘Access to power outlets’ (65.3%) were also considered important by many students. ‘Other’ factors were highlighted as important to the lowest proportion of students. Specified answers included ‘Big tables’, ‘How late it is open’, and ‘Good lighting’. ‘Wall-paint colour’, ‘Presence of indoor plants’, and ‘Views with outdoor plants’ were each deemed important by only a small proportion of people.

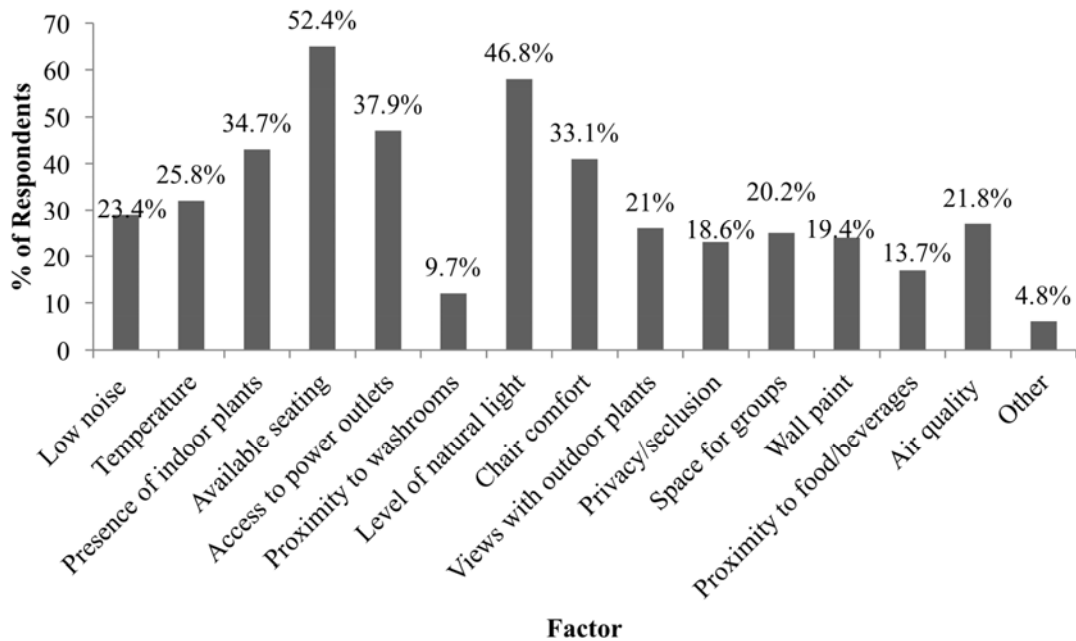


Figure 5: Proportion of Dalhousie students who believe each given factor of the built environment needs to be improved in study spaces on Studley campus. *Note: proportions do not total to 100% because multiple responses were allowed.

The built-environment factor found to need improvement in study spaces on Studley campus by the highest proportion of students was ‘Available seating’, followed closely by ‘Levels of natural light’ (Figure 5). The lowest proportion of students indicated ‘other’ factors to need improvement, which included the presence of fountains and standing work areas. A low proportion of students also indicated ‘Proximity to washrooms’ and ‘Proximity to food and beverage providers’ as needing improvement.

Effect of built environment on stress, anxiety, productivity, and sense of community

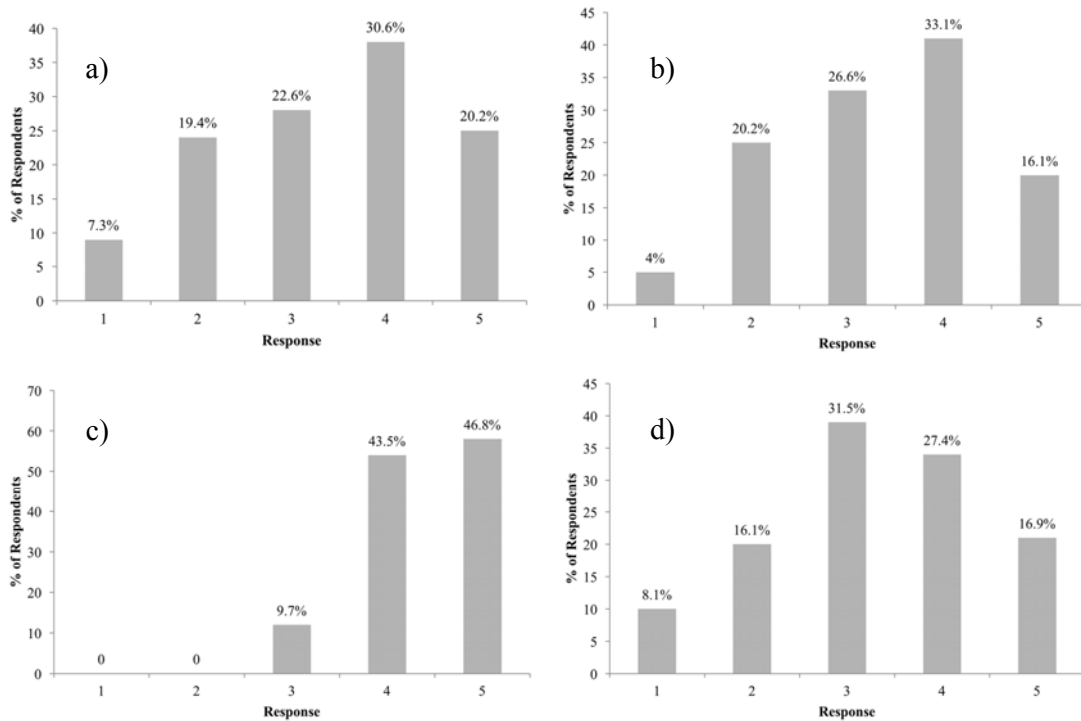


Figure 6: Dalhousie student rankings of the perceived influence of the built environment of on-campus study spaces on: a) anxiety, b) stress, c) productivity, and d) sense of community, based on a 1-5 ranking scale where 1= not at all and 5 = very much.

The built-environment of study spaces was found to have the highest perceived influence on productivity (vs. anxiety, stress, or a sense of community on campus), as it received the highest proportion of 4s and 5s on the 1-5 ranking scale, and received no scores of 1 or 2 (Figure 6). Stress and anxiety showed similar response patterns, with 4 having the highest proportion of responses for both. A sense of community (defined as “ability to connect/interact with peers, professors/mentors, and/or the rest of the Dalhousie community”) on campus received a lower proportion of 4s and 5s than anxiety, stress, and productivity, and the highest proportion of respondents scored it as 3 out of 5.

Additional comments regarding on-campus study spaces

Comments were left in our open-ended question by 30.6% of respondents. Of the 38 comments, only 2 were positive, and contained general statements of contentment with the current state of study spaces. In total, 21% of respondents made comments about potential improvements that could be made, most of which related to natural light and brightness of study spaces. There were 24 key concerns listed regarding study spaces, the most common of which was the limited hours of operation (25% of concerns). Other notable adjectives used to describe on-campus study spaces were: sterile, dirty, cold, and depressing.

Seven potential on-campus study locations were directly referenced in the open-ended question. The Killam Library was most referenced, with one positive comment, one neutral, and eight negative. There was variation in the negative comments, including comparisons to a dungeon/war bunker. The Killam was the only building to receive negative comments, as the other buildings were mentioned to highlight their excellence in some capacity.

Discussion

The purpose of our study was to determine Dalhousie student perceptions of the built environment (defined as the man-made surroundings used by humans) on Studley campus. By determining these perceptions, our aim was to provide recommendations on how study spaces could be improved to benefit students by lowering their stress and anxiety, increasing productivity, and creating a better sense of community on campus.

Time spent studying on Studley campus

The higher proportion of students who spend more time studying off-campus may be taken as an indication that more students prefer to study off-campus. However, some students commented in the open-ended portions of our survey that they were concerned with the operational hours of on-campus study spaces. It could be that students spend more time studying off-campus because they prefer to study during non-operational hours of on-campus study spaces. Another factor that may promote off-campus studying could be the distance between home and campus, which could deter students from traveling to campus to study on days when they do not have to go to campus for class. However, this factor may also promote on-campus studying, if students are studying on-campus in between classes due to this distance. A respondent commented in the open-ended question in our survey that they only study on campus between classes, since it is too far to take the bus home to study.

Most students indicated spending between 4-12 hours/week studying on campus. This, combined with the relatively high proportion of students who do study on campus (even though they are not the majority), indicates that improving on-campus study spaces will benefit a large number of students. Improving on-campus study spaces may also help to create areas that appeal to students who currently spend more time studying off-campus. Increasing the number of students studying on-campus, and the number of hours spent studying on campus, could result in a greater sense of community overall.

Preferred study location

The Killam Library and the Wallace McCain Learning Commons (WMLC) were by far the most preferred study spaces (Figure 3). These results were not unexpected, as these two study areas are some of the largest and most visible on Studley campus. They consist of areas filled with desks for the sole purpose of studying, whereas some of the other buildings listed on the questionnaire were designed more for classroom learning or social gatherings.

A large proportion (57%) of students sampled indicated their year of study to be first or second (Appendix B, Figure C). These students may be still “discovering” the campus and are unlikely to know about the wide range of study spaces available to students (on or off campus). These students may see the Killam as a typical study space because it is a “library”, which may help explain why it is such a popular study space. The other “library” mentioned is called the Sir James Dunn *Law* Library, which may not be seen as accessible to first and second-year students because they are not currently pursuing a law degree, and “law” is specified in the name of the library.

The Killam Library may also be the preferred study space for many other reasons. A large proportion of students indicated that they consider such factors as ‘Low noise’, ‘Available seating’, and ‘Access to power outlets’ when choosing a study space (Figure 4). The Killam Library has a lot of seating, and each seat has access to a power outlet. Additionally, the Killam has several floors where talking is not permitted. The Killam also has various food and beverage providers within the building, and has washrooms on each

floor—satisfying ‘Proximity to food and beverage providers’ and ‘Proximity to washrooms’ which were both indicated as important to a relatively high proportion of students (Figure 4).

However, given some attributes of the built environment of the Killam Library, and some of the comments provided in the last question of the survey, it is somewhat surprising that the Killam was as preferred as it was. The Killam has low levels of natural light and is often found to be cold in terms of temperature, as indicated by some respondents (and is evident by walking into the building). These factors were deemed important by a relatively high proportion of respondents (48.4% and 50%, respectively; Figure 4), so dissatisfaction with these factors should result in the Killam being a less popular study space. The Killam also received the only negative comments in the open-ended question and was even compared to a war bunker and a dungeon. It could be that the Killam is not an ideal study location, but there are currently few better options with adequate seating on campus.

The WMLC serves as a main entrance to the Life Sciences Centre, which results in lots of student foot traffic and makes it very visible to students. This space provides ‘Low noise’ in some areas, has comfortable chairs and lots of natural light, and is close to washrooms and one food/beverage provider, which are all factors a relatively high proportion of students consider when choosing a study space (Figure 4). The lack of seating and tables (due to the smaller size of the building) may be the reason the WMLC was not as preferred as the Killam. ‘Available seating’ was the factor deemed by a high proportion of students to need improvement (Figure 5), and this could be in part due to the lack of seating in the WMLC. Increased seating in this space may increase its popularity even further.

The relatively low proportions of students indicating a preference for the other buildings (Figure 3) listed may be the result of inadequate seating due to their smaller size. Many of the other buildings also lack notoriety as a defined ‘study space’, and may be instead seen as buildings that house classrooms (such as the Mona Campbell and Life Sciences Centre) or are used for social gatherings (such as the Student Union Building).

Built-environment factors considered and needing improvement

The factors of the built environment deemed important by the most students were not surprising. ‘Low noise’ was the most selected (Figure 4), possibly because low noise reduces distraction and improves ability to perform tasks (Cassidy & MacDonald, 2007), and has been correlated with higher test scores (Zimmerman, 2003) and lower levels of psychosocial stress (Leather et al., 2003). Studying in quiet spaces may allow greater focus and thus not only improve grades, but also reduce the amount of time spent studying. This, combined with lower levels of stress, may lead to students actively seeking out quiet study environments. It could also help explain why the Killam Library was indicated as the most preferred study location (Figure 3), since many floors in the Killam Library do not allow talking and if students find part of the library too loud, they can send a text message to the Killam Library Service Point, with details regarding who is causing the disturbance and where, and the staff will deal with it (Charlton, 2015). The popularity of the Killam Library and the availability of these texts, may be why ‘Low noise’ was not deemed to need improvement by a relatively high proportion of students (Figure 5).

A high proportion of students indicated available seating as an important factor when choosing a study space (Figure 4), and it was the factor that the most students indicated as needing improvement (Figure 5). These results suggest there is currently inadequate seating in study areas on Studley campus. Access to power outlets was also deemed important by a high proportion of students (Figure 4), likely due to modern reliance on computers and technology in the university environment. This factor had the third-highest proportion of student responses saying it needed to be improved on campus (Figure 5), indicating the factor

is both important to students and currently the campus is not meeting demand for it. The lack of power outlets available in study spaces could be due to the age of some buildings on campus, which were constructed well before computers became commonplace in the university classroom.

Given the benefits of plants, whether indoor or outdoor, on lowering levels of stress and anxiety (Hipp et al., 2016) and promoting an on-campus sense of community (Joye, 2007; Banning et al., 2010), it was surprising that the two factors regarding on-campus plants were two of the least-selected important factors (Figure 4). This result could be due to students not being aware that having plants in their surrounding gives these beneficial effects or not being aware that plants are part of the overall aesthetic environment in which they prefer to study. Interestingly, a relatively large proportion (34.9%) of students believe the presence of indoor plants could be improved on campus (Figure 5)—a proportion larger than those believing indoor plants are an important factor when choosing a study space. This may indicate that although students do not actively seek out places with more plants, they have noticed the absence of them around campus. If plants were more common in study areas, they may become an important factor when students choose study spaces.

Effect of built environment on productivity, stress, anxiety, and sense of community

Productivity was the element found to be perceived as most affected by aspects of the built environment of study spaces (Figure 6). This could help explain why low noise was the most considered factor when choosing a study space, as research has found that low noise is correlated with greater academic achievement (Zimmerman, 2003) and reduced distraction and increased ability to complete tasks (Cassidy & MacDonald, 2007; Mak & Lui, 2012). The open-ended portion of our survey also included comments stating that the respondent needs quiet to study, or dislikes talking in study areas, which may be related to the need for quiet to be productive while studying. High levels of natural light have also been found to increase workplace productivity/performance and learning rate (Boubekri et al., 2014; Edwards & Torcellini, 2002; Hua, Oswald, & Yang, 2011). Natural light was a factor deemed to need improvement by a high proportion of students (Figure 5), which indicates an area of the built environment that could be improved in study spaces to promote better productivity on campus.

Research has also found that ergonomic furniture promoting comfortable seating positions increases typing efficiency (an essential skill in modern university) and increases concentration and attention levels in students (Haynes & Williams, 2008; Yang, Becerik-Gerber, & Mino, 2013). A moderately high proportion of students indicated ‘chair comfort’ as being important when choosing a study space *and* needing improvement on Studley campus. The desire for comfortable chairs could be due to their effect on productivity, and if improved on Studley campus may benefit students academically.

Stress and anxiety were both seen as being moderately-to-greatly influenced by the built environment of study spaces (Figure 6). Much research has been done showing that students spending more time in areas with a greater number of plants indicate having lower stress and anxiety levels (Hipp et al., 2016). Simply looking out windows at plants, or at pictures containing plants, has been shown to reduce stress and fatigue, and improve mood overall (Kaplan, 2001; Wilkie & Clouston, 2015). It has even been found that students with high stress levels prefer spending time in areas with plants or windows overlooking plants (Windhorst & Williams, 2016). However, ‘Presence of indoor plants’ and ‘Views with outdoor plants’ were two of the factors that received the lowest proportion of responses in terms of factors considered when choosing a study space (Figure 4). It could be that students do not make the cognitive connection between the presence of plants and their effects on

stress and anxiety. It could also be because Studley campus is currently lacking in plants (inside or out), as indicated by the relatively higher proportion of students who indicated that the presence of plants needs to be improved on campus (Figure 5). If there is a lack of plants overall, then students may not consider this when choosing a study space, as there are no spaces with plants to consider. If more plants were added inside and outside of study spaces, this may become a more important factor for students when selecting a study space.

A sense of community was the element deemed to be influenced only moderately by the built environment, as indicated by the highest proportion of respondents (Figure 6). Research has found that areas with open spaces and larger tables and lots of seating facilitate interaction in academic settings (Banning et al., 2010; Harrington, 2014). However, 'Space for groups' was indicated as being considered by only a moderate proportion of respondents when choosing a study space (Figure 4), and only a moderate proportion indicated that it needed to be improved on campus (Figure 5). Studying is often viewed as a solitary activity, and students may not be concerned with feeling a sense of community while studying as opposed to when participating in activities on campus that are more social in nature. Previous research has indicated that students value quiet areas with privacy and seclusion when studying (Banning et al. 2010). This, combined with the high importance of 'Low noise' (Figure 4), suggests that feeling a sense of community on campus may not be important when studying because interactions with peers/mentors/professors may be associated with noise that is not conducive to studying.

Conclusions

Based on the data we obtained, Dalhousie University should target improvements to the Killam Library and Wallace McCain Learning Commons, as they are the most-popular study spaces. The factors they should focus on improving are first and foremost, those deemed to need improvement (available seating, natural light, and access to power outlets). However, Dalhousie should also give consideration to those simply deemed important when choosing a study space (low noise, available seating, and access to power outlets), as these may be lacking in certain study spaces and not in general. Due to the perceived high influence of the built environment on student productivity, Dalhousie should also focus on improving factors known to increase productivity, such as comfortable seating, natural light, and low noise. Despite there being a low indication that students consider the presence of plants when choosing a study space, increasing indoor/outdoor plants may benefit student stress and anxiety, which could later result in students considering these factors more.

By targeting popular study spaces, and the factors of the built environment deemed important when choosing a study space and/or to need improvement, Dalhousie can target improvements to the study spaces that will have the greatest benefit on the highest number of students. These improvements could also help Dalhousie in achieving two of its main campus sustainability goals, by promoting the health and social characteristics of the university, and attracting people to the school because of its sustainability.

Student choices regarding study space are complex and are unlikely to be limited to only aspects of the built environment. Further research should be undertaken to ascertain whether social, cultural, or other aspects influence where students prefer to study. Our study made no comparisons between groups of people (whether based on degree program, gender identity, year of study, etc.) so we cannot ascertain whether different groups value different factors when choosing a study space. Future research in this area could uncover any potential differences, which would allow for the creation of study spaces that benefit all groups of individuals.

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Appendix A: Questionnaire used in study

The following survey is being used to evaluate the Dalhousie student perception of the built environment (the man-made surroundings used by humans) of study spaces on Studley campus. Results of this study will be incorporated into a class project and be distributed to key decision makers to encourage and inform improvements and future development of on-campus study spaces. By completing the survey, you are consenting to allow your answers to be used for the purpose described above. To maintain confidentiality, please do not include your name or any other identifying information on the survey. Once the survey is complete, please place it inside the envelope provided.

Program of study: _____ **Year of study:** _____

Current location: _____

1. Do you spend more non-class hours studying on Dalhousie Studley campus, or off-campus/in your residence building?

On campus

Off campus/In residence

2. How many non-classroom hours do you spend studying/doing coursework on campus per week?

<4 hours

4-8 hours

8-12 hours

12-16 hours

16-20 hours

20+ hours

3. Please circle which of the following on-campus areas is your most preferred for studying outside of the classroom.

1. Wallace McCain Learning Commons

2. Killam Library

3. Mona Campbell Building

4. Life Sciences Centre

5. Rowe Management Building

6. Student Union Building

7. Sir James Dunn Law Library

8. Computer Science Building

9. Weldon Law Building

10. Other (please specify): _____

4. Which of the following factors do you consider when choosing a study space on campus? Please circle all that apply.

1. Low noise level

2. Comfortable temperature

3. Presence of indoor plants/greenery

4. Available seating

5. Access to power outlets

6. Proximity to washrooms

7. High levels of natural light

8. Comfort of chairs/desks

9. View with outdoor plants/greenery

10. Privacy/seclusion

11. Space for group work

12. Colourful/bright wall paint

13. Proximity to food/beverage providers 14. Good ventilation and air quality
 15. Other (please specify): _____

5. Which of the following factors do you think could be improved on the Dalhousie Studley campus? Please circle all that apply.

- | | |
|--|--------------------------------------|
| 1. Low noise level | 2. Comfortable temperature |
| 3. Presence of indoor plants/greenery | 4. Available seating |
| 5. Access to power outlets | 6. Proximity to washrooms |
| 7. High levels of natural light | 8. Comfortable chairs/desks |
| 9. View with outdoor plants/greenery | 10. Privacy/seclusion |
| 11. Space for group work | 12. Colourful/bright wall paint |
| 13. Proximity to food/beverage providers | 14. Good ventilation and air quality |
| 15. Other (please specify): _____ | |

6. On a scale of 1 to 5 (1 = not at all, 5 = very much), to what degree do you feel your study space influences your productivity?

1 2 3 4 5

7. On a scale of 1 to 5 (1 = not at all, 5 = very much), to what degree do you feel your study space affects your levels of anxiety?

1 2 3 4 5

8. On a scale of 1 to 5 (1 = not at all, 5 = very much), to what degree do you feel your study space affects your stress level?

1 2 3 4 5

9. On a scale of 1 to 5 (1 = not at all, 5 = very much), to what degree do you feel your study space influences your ability to connect/interact with your peers, professors/mentors, and/or the rest of the Dalhousie community?

1 2 3 4 5

10. Please use the space provided below to express any other comments/concerns you have about the current state of study spaces on the Dalhousie Studley campus, which were not captured by the questions above.

Thank you for completing the survey! Your answers are greatly appreciated.

Appendix B: Sample demographics.

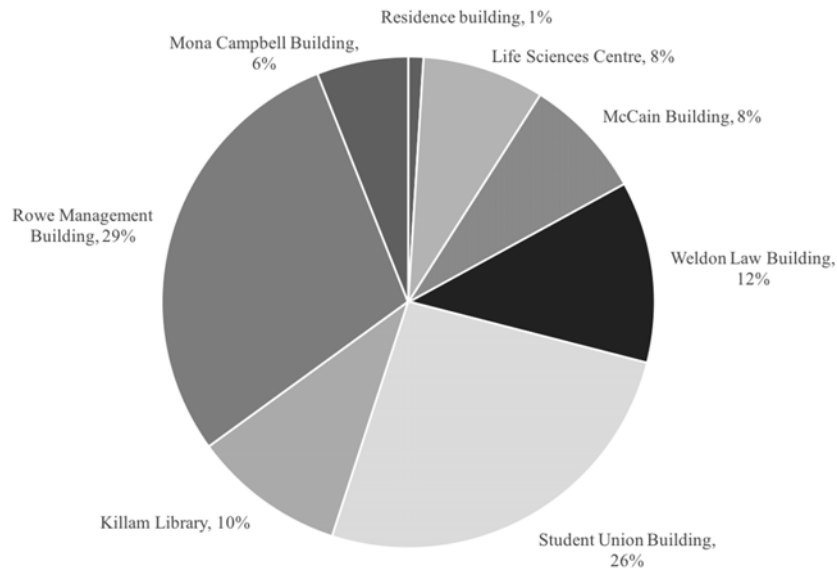


Figure A: The 124 respondents sorted by location where they were sampled.

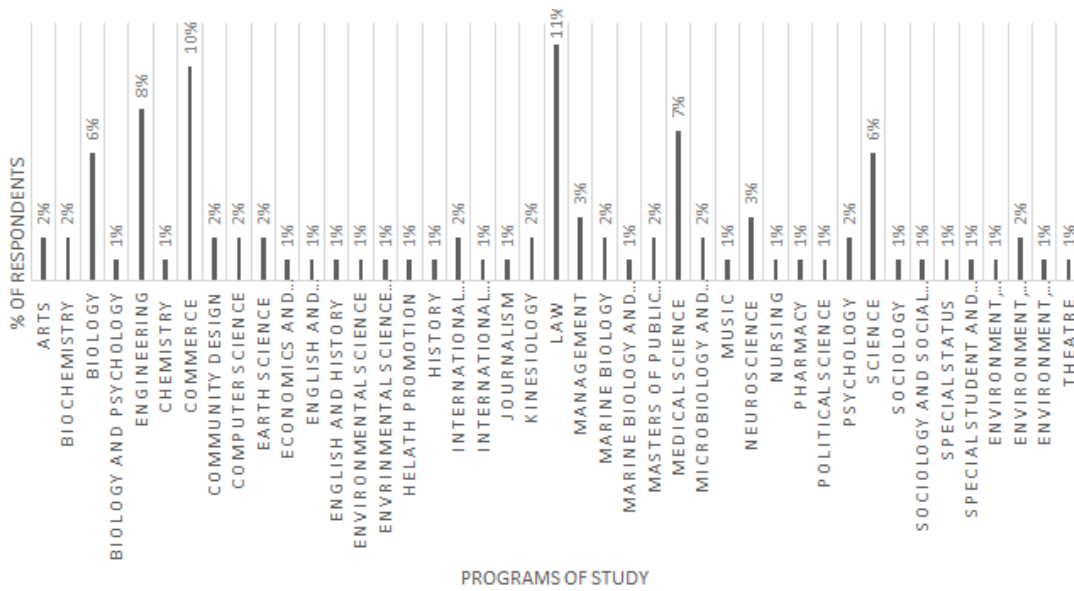


Figure B: The 124 respondents sorted by degree program.

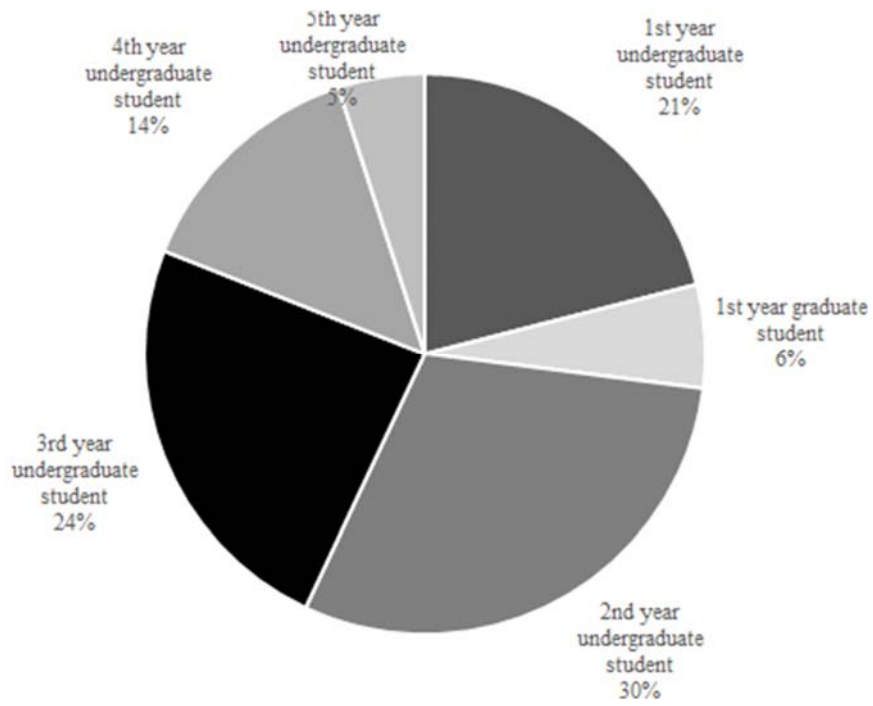


Figure C: The 124 respondents as sorted by year of study