

Assessing the Understanding, Awareness, and Concern for Climate Change across Undergraduate Faculties at Dalhousie University



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Executive Summary

The research completed in this study evaluates the levels of understanding, awareness, and concern for climate change of current undergraduate students in Dalhousie University's Faculties of Engineering, Science, Health Professions, Architecture and Planning, Management, and Arts and Social Sciences. This was done through an optional online survey, which received 242 respondents from five faculties: Science, Arts and Social Sciences, Architecture and Planning, Engineering, Health Professions and Management. By analyzing the results through descriptive and inferential statistics, it was found that students in the Faculties of Science and Faculty of Architecture and Planning demonstrated higher levels of awareness, understanding, and concern for climate change than the other faculties. Therefore, it is recommended that Dalhousie University expand its integration of climate change into academic curricula in the Faculties of Engineering, Health Professions, Management, and Arts and Social Sciences.

Introduction

Background

Dalhousie University is one of the few universities in Canada to offer an interdisciplinary undergraduate degree in environmental sustainability. Being an interdisciplinary program, students are free to combine sustainability studies with another topic. Dalhousie is demonstrating that it recognized the complexity of sustainability by combining it with traditional disciplines, though it still offers traditional degree programs without the integration of sustainability into the curriculum. However, Cortese (2003) suggests that the traditional education system perpetuates assumptions about our world that do not accurately reflect the reality of environmental issues. While Dalhousie University's existing environmental programs are robust and interdisciplinary, we recognize that environmental courses offered as electives are often not accessible or are too specialized for many students. Being a complex issue, education on climate change and environmental issues must be multifaceted to reflect that complexity.

Education for sustainable development does not simply represent a single, new curriculum area for schools (e.g. environmental studies), but rather is a more integrated approach to providing appropriate education and training in a diverse and rapidly changing world. (Bangay & Blum, 2010)

Often students are not challenged to question presumptions that resources are infinite, ecosystem impacts of human activity are absorbed easily, and that individual success is more important than community health (Cortese, 2003 & Arbuthnott, 2009). As publicly-funded institutions committed to preparing the next generation, universities such as Dalhousie play a key role in shaping students' understanding and awareness of environmental issues. Addressing climate change requires knowledge and skills and should be imparted in higher education across all disciplines (Anderson, 2012 & Bangay & Blum, 2010). Situating higher education studies in a greater environmental context is therefore important, as is the way that environmental issues are taught to students. Anderson (2012) stresses that an interdisciplinary approach to teaching is necessary in order to adequately address the scope of such fundamental issues. Focusing only on narrow "climate literacy and environmental education within science class" is therefore not enough (Anderson, 2012, p.193). Building an education system around "more holistic ways of addressing climate change" (Bangay & Blum, 2010, p.363) allows students in all disciplines to address these issues.

A study conducted at Dalhousie University measured the impact of taking an introductory environmental studies course on students' environmental attitudes, and found that participants prioritized their environmental values if this class was taken (McMillan, Wright & Beazley, 2004). Though participants demonstrated high levels of environmental awareness before taking the class, McMillan et al. (2004) found that environmental issues were more highly valued after

taking the class. While McMillan et al. (2004) do note an absence in research on the long-term impacts of basic environmental education on personal values, the results of this study are consistent with other studies. This study implies that environmental education is successful in transmitting environmental awareness and valuation to students.

Goals and Objectives

The purpose of this study is to assess the understanding, awareness, and concern for climate change among current undergraduate students across different faculties at Dalhousie University. With climate change adaptation becoming a pressing issue both a global and local level, having a better understanding of the degree to which people are aware of, understand, and are concerned about climate change is important. According to the International Council on Human Rights Policy (2008) believes that, "Education is as important as health: a well-educated population is better equipped to recognise in advance the threats posed by a changing climate and to make preparations". It is worth determining where environmental education can be improved in the post-secondary education system.

Dalhousie University is used as test model to better understand how aware students are of both climate change and its effects. We will also assess students' current knowledge of climate change and whether or not they are concerned.

An emphasis on environmental education across faculties is key to our study, which aims to evaluate the pervasiveness of environmental themes across department curricula at Dalhousie University. We will assess undergraduate students' level of awareness, understanding, and concern for climate change. Multiple faculties will be surveyed in order to evaluate whether or not Dalhousie is successfully integrating environmental education and awareness throughout its academic programs.

The goal of this research is to gain a better understanding of which programs at Dalhousie could improve climate change education, awareness, and initiatives. The results of this research could apply to policy at local and global levels to address climate change. At Dalhousie our findings could influence curriculum selection, and general information distribution to different programs. This study could also potentially impact campus policy and help Dalhousie move towards a more environmentally conscious campus.

This research specifically addresses the levels of concern, understanding, and awareness amongst Dalhousie undergraduate students. This information is important in creating a baseline understanding of Dalhousie's population as a whole and in assessing improvements in the future. It is the first of its kind at Dalhousie, and will hopefully provide some insight on areas at Dalhousie that require improvement in regards to climate change education. This research is also important as it could be the beginning of a network of similar studies across universities, which could prove important information moving forward in addressing climate change issues.

Research Question

Our primary research question is:

How does the understanding, awareness, and concern for climate change differ across undergraduate students in different faculties at Dalhousie University?

The research question will be addressed according to the following definitions:

Understanding – whether students have a basic understanding or knowledge of what climate change is and how it works.

Awareness – whether students are aware of issues surrounding climate change and actions they might take to address climate change.

Concern – whether students care about climate change or are inspired to act to address climate change and related issues of their own personal prerogative.

Methods

Study Design

This study was designed as a non-probabilistic online survey with multiple styles of sampling methods. To begin, snowball sampling was used to carry out this study, as department administrators at Dalhousie University aided in the distribution of the online survey, using their network of students to expand the number of respondents. We also used convenience sampling, cluster sampling, and quota sampling once the survey was sent out in order to narrow our choices. It was decided which departments would be used for the study once the quota of at least 15 respondents was met, and it was then decided which departments would be studied according to the amount of responses gathered from students in that department.

An online survey using Google Forms was chosen to collect data for this research. A survey was chosen for this project because the research question could be answered by asking mostly closed-ended questions. A survey can accomplish this in a more time efficient manner and to a wider population than interviews (Palys & Atchison, 2014). Google Forms was chosen because it is reliable, easy to use, and also free of charge both to distribute the survey and to download the results. The online survey format ensured that a larger sample size would be met for this research. The online format also allowed the respondents to complete the survey on their own time, rather than at the immediate distribution of a survey handed out in person which allowed for the collection of more results.

Sample Population

The population that was used for this research was current undergraduate students on Studley, Sexton, or Carleton campuses at Dalhousie University. There was no specific criteria for the year of study, age, or gender of the students that responded to the online survey, as these

were not relevant for the focus of this project's research question. We decided to focus only on Dalhousie University students located in Halifax to make the sample size more manageable in the small time frame of this study.

Research Procedures

The majority of the survey consisted of a variety of closed-ended questions. Some questions utilized the Likert-scale format, while others were open-ended (see Appendix B). To distribute the survey we emailed program administrators as found on Dalhousie University's website, asking to utilize their distribution list. The email sent out to each department at Dalhousie University introduced the research team, project objectives, instructions for completing the survey, and a message about consent (Appendix A). From there the email was distributed to students in many different programs. The research team also used their personal connections on social media to promote the survey to Dalhousie University students within their personal social network. As an incentive for participation a chance to win a \$25 gift card for Tim Hortons was offered to all participants who completed the survey and voluntarily left their email address.

The survey was open to respondents for one week from March 21st, 2017 to March 28th, 2017. Once the survey closed, the answers to each question was downloaded from the Google Forms website to a Microsoft Excel spreadsheet. We omitted any responder who:

- Indicated that they were double majors
- Did not indicate their faculty or major
- and/or was a student from the Truro campus

The singular open ended question in the survey (Question 6) required the answers to be coded, so we could find averages and conduct a chi-square test. Each student's answer to the question was given a mark out of three. Receiving full marks on this question required mentioning the human-caused aspect of climate change (1 point), mentioning the source of emissions such as CO₂ or fossil fuels (1 point), as well as demonstrating some knowledge of the mechanisms of heat trapping in the atmosphere (1 point). In addition, specific coding for chi-squared tests involved coding Likert-style questions into three categories as being below, at, or above a median value. The scores on the open-ended question and the responses to binary questions were left intact for chi square analysis. Some response data was edited to tailor results to the focus of our study and simplify results during chi analysis. For example: when using data from a question on the source of a respondent's knowledge about climate change (Question 8), the research team changed the data to a binary response - changing responses to indicate receiving their knowledge about climate change from university courses or elsewhere. In our descriptive graphs we kept multiple response categories of this data intact.

Reliability and Trustworthiness of Research Procedures

Our research collected data from a large spread of respondents across all years of study, but skewed towards more third year responses and less first year students (Figure 14). Due to this the year of study of respondents was not analyzed when assessing faculties. It was noted that having a high degree of first year students could skew results, as they might not have had a chance to become educated on topics of climate change and may have no clear indication of the amount of classes offered or the amount of classes that touched on the topic. They may also not have a clear indication of the amount of emphasis placed on climate change within their program. However, due to lower numbers of first year respondents we chose to include their responses

Human error in recording and categorizing data collected is a potential reliability issue. Should this study be repeated in the future, some questions would need to be clarified for the respondents. One clarification we would make if repeating our survey would be using a drop down menu for Question 1 (Appendix B). Having students indicate their faculty and department from a list ensures there is no uncertainty, miscommunication, or miscategorization of data collected. In this question some students either did not completely understand what the terms (such as faculty vs. major) meant, or they only filled out one, leaving gaps in our data.

We would also change the open-ended question related to climate change understanding (Question 6). In the future, the question would be reworded to: “To the best of your ability, please briefly describe what climate change is and how it works.” This would eliminate the sentence restraints as well as some of the more creative answers that arose from “in your own words”.

We noticed that in questions where multiple answers could have been selected by the respondents, multiple answers were not selected. Changing these questions to indicate that respondents could choose all answers that apply would be beneficial for accuracy of the final results.

To address many of these reliability issues, it would have been best to do a larger sample. Given the strict time restraints this was not possible. Issues were also encountered with people not completing the full survey, making it difficult to assess the individual and make comparisons. Surveys that went uncompleted were removed from our analysis. To address this in the future, all questions would be mandatory for completion before the survey could be successfully submitted.

For the question that was used to assess awareness, understanding, and climate skepticism (Question 4, Appendix B), adjustment to could be made. Wording should account for the fact that climate change is a natural process that humans have drastically altered and accelerated. The research team felt that there was the potential for more “maybe” responses because many people believe humans are the cause, but they also have the background understanding to consider the natural impacts surrounding climate change. This could potentially skew our findings.

Validity of Research Procedures

As with any publically available online survey, there were issues surrounding who answers the survey and the truthfulness of the responses. It is also difficult to determine if the respondents are actually part of the desired sample population.

There were issues when dividing respondents according to faculty and major. Many respondents did not specify both a faculty and a major, or put only one. In instances where there was only a major, the faculty had to be assumed. This could raise some minor issues regarding which faculty a major would fall under as some majors could be categorized under more than one faculty.

It is possible that not all departments or faculty administrators distributed the email to students. This was recognized as a possibility by the research team as narrow range of departments at Dalhousie University were collected. This could skew results, as well as jeopardize getting a representative sample of the students.

Assumptions

Many assumptions were made throughout all aspects of this project. For Question 4 (see Appendix B), which asked “Do you think that climate change is due to human influence?” if students answered “Maybe”, or “N/A,” we assumed that the respondent did not believe that climate change is due to human influence. A score of zero was given when “Maybe” and “N/A” were given as answers, on top of the answer “No,” for Question 3 for both understanding and awareness in that section.

For Question 6 (Appendix B), which stated, “Explain what climate change is and how it works in a couple of sentences,” the research team aimed to measure whether the student had a basic understanding of climate change. We defined basic climate literacy as three criterion:

- whether the respondent mentioned greenhouse gas emissions, carbon dioxide, pollution, or some variation therein as the reason behind climate change;
- whether the respondent acknowledged that the root cause behind aforementioned emissions, and climate change as a whole, is due to human interaction and interference;
- whether the respondent discussed that the Earth was warming and/or that shifts in weather patterns and temperatures over a large scale and time period are being noticed.

If the respondent incorporated the three criterion in their response, the research team assumed that the respondent had a basic understanding of climate change.

For the Likert-scale questions in the survey (Questions 5, 7, 8 and 9 in Appendix B), it is assumed that all respondents had a uniform understanding of each of the ranked choices. For instance, each student would say that ranking themselves “extremely well” in terms of their understanding of climate change (Question 5) would indicate that they fully understand climate

change and how it works. There is a significant amount of subjectivity when answering these types of questions.

If a student participates in initiatives/events/societies etc. surrounding climate change (Question 10), then we assumed that the student has a higher level of concern than those students who do not participate. Furthermore, students are willing to participate in initiatives/events/societies etc. if they are given more awareness and information about them (Question 11).

We assumed that the respondents answered truthfully to all questions. Past Dalhousie University students, graduate Dalhousie University students, or non-Dalhousie University students could have gained access to the online survey and completed it regardless of the specified respondent criteria. For our data we assumed that only current undergraduate Dalhousie University students completed the survey.

It was assumed that the information collected from the sample population for each faculty from this survey is representative of the understanding, awareness, and concern for climate change for the faculty as a whole at Dalhousie University.

For some of the surveys that were completed the respondents indicated that they were in a program which could fall under two different faculties. This issue only occurred with those students that listed their major as Recreation Management, which could fall under both the Faculty of Science and the Faculty of Management. In these cases we grouped these surveys under the faculty of management. We also grouped both Management and Commerce majors together under the Faculty of Management. Both programs have crossover between required classes leading to the conclusion that they were similar enough to be grouped for analysis. Due to issues with double counting individuals who were double majors in multiple faculties, we eliminated all double majors.

Limitations

Limitations to the data collected from this survey came from the inability to access a list of undergraduate student emails, which meant relying on undergraduate program administrators to distribute the survey. A survey distributed via email is also easily ignored or deleted. Since this project was limited to only the students who voluntarily chose to complete the survey, the faculties that were chosen and analyzed were also limited. Once data collection was completed, some faculties only had a small number of respondents who completed the survey. Consequently, these faculties could not be focused on in this study, as a small size does not provide a significant sample. This specifically relates to the Faculty of Computer Science which was unable to be assessed due to a low response rate.

The largest limitation on this research project was the short time frame of the study. With such a limited amount of time, this meant follow up interviews with respondents to clarify questions, as well as the opportunity for respondents to clarify any misunderstandings with the research team, were not possible. More analysis regarding majors and year of study might have been made possible if more time was available. As a result, the analysis of this information could

have potentially allowed the research team to garner a better understanding of areas that Dalhousie University should target for improvement around climate change education.

It is also important to note that the greater proportion of third and fourth year students surveyed could have skewed the results by showing a greater understanding of climate change compared to if all years had equal sample sizes. However, since the research team decided that the year of study of the respondents would not be focused on in this research's analysis, it was concluded that any proportion of students in each year of study was acceptable in order to assess the understanding, awareness, and concern for climate change amongst Dalhousie University students in different faculties.

Delimitations

Delimitations created by the research team included narrowing the scope of participants to that of current undergraduate students at Dalhousie University, and targeting only Studley, Carleton and Sexton Campuses. Keeping the study population within Halifax was more realistic for valuable and consistent results. The research team limited the number of faculties that would be analysed based on the highest response rate as well. These delimitations all worked together to ensure a better picture of Dalhousie Undergraduates as a whole.

Results

A total of 331 students participated in our survey over the week it was available. After omitting respondents that indicated that they were a double major, that did not indicate their major or faculty, or that were from Truro Campus, the total sample size for this project was reduced to 242 students.

Of these 242 respondents: 18 were in the Faculty of Architecture and Planning (Ar Pl), 22 were in the Faculty of Engineering (Eng), 25 were a part of the Faculty of Arts and Social Sciences (FASS), 32 respondents were in the Faculty of Health Professions (FHP), 41 were in the Faculty of Management (Mgmt), and lastly, the remaining 104 respondents were in the Faculty of Science (Sc).

We received responses from students across all years of study from Dalhousie University (Figure 14). In particular we received responses from a higher proportion of third and fourth year students, at 38% and 26% respectively, and a much lower proportion of first year students (15%).

Understanding

The majority of the students that were surveyed believed that the climate is changing (see Figure 1), with only 2% of the sample population denying the existence of climate change. Of the 98% of respondents that believe that the climate is changing, 92% believe that climate change is human caused, 7% of respondents are unsure as to whether climate change is human caused, and 1% believe that climate change is not human caused (Figure 2).

According to Figure 3, the Faculties of Engineering, Science, and Architecture and Planning had higher than expected counts for their self-reported understanding of climate change (Table 1). They also rated their understanding of climate change between the range of somewhat strong to extremely strong; about 65%, 63%, and 60%, respectively. Respondents in these faculties have at least a “somewhat strong” understanding of climate change. In contrast, the Faculty of Arts and Social Sciences indicated the greatest self-reported percentage of “weak” understanding of climate change at 18% of FASS respondents (Figure 3).

After coding Question 6 and the comprehension of the respondent was measured; the Faculties of Science and Architecture and Planning showed approximately equal or greater actual understanding in comparison to when these faculties rated their understanding themselves, as well as greater observed counts than what was expected was calculated (Table 2). The Faculty of Architecture and Planning showed almost 80% of respondents having at least a “good” understanding of climate change, with the Faculty of Science reaching almost 60% of respondents indicating a “good” understanding (Figure 4). Despite the Faculty of Engineering rating their understanding as relatively strong, slightly over 60% of this faculty actually showed a “poor” understanding of climate change when the research team measured their understanding through question 6 (Figure 4), and additionally, this faculty had lower observed counts than what was expected (Table 2) for their understanding. Finally, in comparison to the other faculties, the Faculty of Arts and Social Sciences did have the highest percentage of self-reported “poor” understanding of climate change, and this faculty did also have the greatest percentage of respondents with an actual “poor” understanding of climate change; approximately 60% of respondents having at least a “poor” understanding of climate change (Figure 4).

For question 8 of the survey (Appendix B), it was found that almost 80% of the respondents in the Faculty of Architecture and Planning received most of their knowledge about climate change from university, followed by the Faculty of Science, of which measured to be about 50% of respondents (Figure 5). In contrast, approximately 95% of the respondents in the Faculty of Health Professions indicated that their knowledge about climate change did not come from university (Figure 5), which was much greater than what was expected (Table 4).

Finally, question 9, of which asked the respondents to determine the approximate significance that is placed upon the topic of climate change within their faculty’s curriculum, indirectly provides information about the students’ understanding of climate change. According to Figure 10, it was found that the Faculty of Architecture and Planning clearly had the largest focus on climate change within their curriculum, of which shows that almost 95% of respondents say that this environmental topic is at least a moderately significant topic within their curriculum. Following the Faculty of Architecture and Planning was the Faculty of Science, of which had slightly over 60% of respondents that believed that climate change was at least a moderately significant topic within their faculty. The observed counts were significantly greater than the expected counts for both of these two faculties in terms of the “quite significant” to “extremely significant” answers that were chosen (Table 5). On the other extreme however, the Faculty of Health Professions had much greater observed counts than expected counts in terms of saying

that their faculty placed no significance at all on the topic of climate change within their curriculum (Table 5); over 65% of respondents in this faculty chose this answer from the survey (Figure 10).

Concern

When the respondents were asked to rate their level of concern for climate change, it was found that the Faculty of Science and the Faculty of Architecture and Planning expressed the highest level of concern relative to their expected counts (Table 3), as well as in comparison to all other faculties (Figure 9). According to Figure 9, approximately 40% of respondents in these two faculties showed extreme concern for climate change. Also, Figure 9 shows that all faculties had a relatively equal percentage of respondents that are fairly concerned with climate change. However, despite this finding, the Faculty of Arts and Social Sciences showed the lowest level of concern for climate change relative to their expected counts (Table 3); almost 10% of respondents in this faculty indicated that they are not concerned at all for climate change (Figure 9).

The Faculty of Science, the Faculty of Architecture and Planning, and the Faculty of Health Professions were more likely than expected to have participated in extracurricular activities related to climate change (Table 6); between 35 -40% of respondents in all three of the Faculties indicated their concern (Figure 11). The Faculties of Management, Engineering, and Arts and Social Sciences were less likely than expected to participate in extracurricular activities that focused on climate change (Table 6), with about 90% of respondents from Management, 80% of respondents from Arts and Social Sciences, and approximately 77% of respondents from Engineering of which indicated their lack of concern for climate change (Figure 11).

When asked whether the student would be willing to participate in climate change related initiatives if they were more informed, the Faculties of Engineering and Management were most likely to respond “no,” which was higher than the expected counts to do so (Table 7) and thus had the lowest levels of concern of the faculties that were selected for analysis (Figure 12). On the other hand, according to Figure 12, approximately 45% of the respondents from the Faculty of Science and the Faculty of Arts and Social Sciences showed great willingness to participate in climate change initiatives if they were more aware, and also much greater than expected for these two faculties to respond “yes” (Table 7), thus demonstrating a greater concern for the topic of climate change.

The Faculty of Science and the Faculty of Architecture and Planning displayed the greatest amount of concern for climate change, whereas the Faculty of Management, the Faculty of Arts and Social Sciences, and the Faculty of Engineering generally showed the highest amount of students of which were not concerned, or at least fairly unconcerned, for climate change.

Awareness

For Question 6 (see Appendix B), which asked the respondent what climate change is and how it works, the Faculty of Architecture and Planning and the Faculty of Science both scored higher than their expected counts (Table 2); 62% of respondents and 50% of respondents, respectively, had excellent understanding of climate change (Figure 4). Additionally, over 50% of respondents in these two faculties had at least a “good” understanding of climate change (Figure 4). Therefore, since these faculties have the highest understanding of the concept of climate change, then these faculties also have the highest awareness of this issue in comparison to the other faculties in this study.

Conversely, the Faculty of Arts and Social Sciences had the lowest level of understanding of climate change, followed by the Faculty of Health Professions, and then the Faculty of Management, with about 37%, 25%, and 20% of respondents in these faculties scoring a zero on question 6 (indicating a “failed” understanding of climate change), respectively (Figure 4). The Faculty of Engineering also had the largest percentage of respondents of which had a “poor” understanding of climate change (score of 1), and the Faculty of Arts and Social Sciences also had a large percentage of respondents in this category, thus putting over 60% of the respondents in these two faculties as having at least a “poor” understanding of climate change (score of 1 or less). Overall, since understanding speaks to the students’ awareness of climate change, the Faculty of Arts and Social Sciences had the greatest number of respondents that had no understanding of climate as well as the largest proportion of students that had a “poor” understanding of climate change, along with the Faculty of Engineering.

Discussion

Climate change presents a complex, multi-disciplinary challenge to contemporary society and therefore some level of understanding, awareness, and concern for this growing issue must be present across all sectors and professional fields in order to solve this wicked problem. The results of the study indicate that certain Dalhousie University faculties, such as the Faculty of Architecture and Planning and the Faculty of Science, are succeeding in integrating climate change into their program curricula. This integration is successful in enhancing students’ attitudes and understanding of climate change. It was also found that some faculties could do more to integrate the topic of climate change into their curriculum, such as the Faculties of Health Professions, Management, Engineering, and Arts and Social Sciences.

Understanding

Results from Figure 4 show that the Faculty of Science and the Faculty of Architecture and Planning scored the highest in their understanding of climate change. The Faculty of Health Professions demonstrated a moderate understanding of climate change, and the Faculties of Arts & Social Sciences and Engineering demonstrated a poor level of understanding of climate

change. Interestingly, levels of self-reported perceived understanding of climate change (Figure 3) were high across all faculties. This did not translate into actual understanding, reflecting a significant knowledge gap. The highest of these discrepancies between perceived and actual understanding occurred in the responses of students from the Faculty of Engineering. The Faculty of Arts and Social Sciences was notably more accurate in their self-assessment of their level of understanding, rating their understanding as lower and receiving lower marks on actual understanding also. This gap between perceived and actual understanding may have implications for climate change policy in the future. Perceptions of understanding as opposed to actual understanding of an issue could potentially be linked to blind spots in policy and risk management.

Results from Figure 6 and Figure 7 show that there is a correlation between gaining the majority of one's knowledge about climate change from university classes and both perceived and actual understanding. These results show that a higher degree of understanding of climate change in students is due to the fact that they received majority of their knowledge about this topic from university. The Faculty of Science and the School of Architecture and Planning both have the highest degrees of self-reported and actual understanding surrounding climate change. These two faculties are also the two with the highest proportion of students who obtained majority of knowledge from university. This lends further to the idea that the two are correlated, as previously demonstrated in McMillan et al's (2004) study of Dalhousie University's undergraduate students. It is also important to note that the levels of perceived understanding correlate with actual understanding, as a lower perceived understanding was generally demonstrated through lower degrees of actual understanding, and higher levels of perceived understanding was generally demonstrated with higher degrees of actual understanding (Figure 8).

Another interesting finding was the descriptions of climate change. One noticeable element that arose through the processing and assessing of Question 6 (Appendix B) was the emphasis on ozone and ozone depletion. A wide range of responses were collected but in particular 10% of answers that suggested that climate change was caused by depletion of the ozone layer, or that ozone depletion was a result of climate change (see Figure 13). Therefore, there needs to be more emphasis placed in Dalhousie University's curriculum surrounding the causes and processes of climate change and ozone depletion in order to better educate people on major differences, as well as underpinning issues and methods of addressing each.

Concern

Figure 10 supports that climate change in the classroom contributes to understanding, as both the Faculty of Science and the Faculty of Architecture and Planning rated their faculty as placing a high level of significance on the topic. These programs saw the highest levels of understanding and concern for climate change. Alternatively, the Faculties of Health Professions and Arts and Social Sciences saw the highest proportion of students that showed little to no concern for climate change in their everyday life. It is possible that significance placed on

climate change in the classroom, coupled with receiving the majority of knowledge about climate change from university, places these students at a higher likelihood to be both aware and concerned about climate change issues.

Results from Figures 11 and 12 allow for the additional analysis of students' concern for climate change through extra-curricular initiatives in which students have participated. Comparing these figures with Figure 9 allows for the comparison of self-reported concern to demonstration of concern. The results appear to be correlated. Higher levels of self-reported concern shows a higher level of participation in extracurricular initiatives for the majority of faculties analyzed. However, this is untrue for the Faculty of Health Professions which displayed a higher level of participation in initiatives related to climate change. Given these results, it is important for the university to further publicize initiatives related to climate change on campus to ensure that this issue is being explored inside and outside the classroom.

Awareness

Figure 14 shows that a variety of students in different academic years at Dalhousie University participated in this research. There is a possibility that a higher year of study could mean a better understanding of climate change. It is expected that students from higher years of study would have been more exposed to the topic of climate change through their classes. Our team hypothesized that first year students would not know which classes included climate change, nor would have taken many that did. However, because a fairly high number of responses came from students in third and fourth year, it was felt that this would not prove an issue in our research.

Five out of 242 student responses indicated that they did not believe that the climate was changing (Figure 1), and 8% of surveyed students were uncertain or did not believe that humans were the main cause of climate change (Figure 2). According to a recent study, the national average of Canadians that are uncertain of, or do not believe in, anthropogenic climate change is 42% (Lachapelle, Borick, & Rabe, 2014). Although the university average in this report is less than the national average, it is still uncertain whether this is higher or lower than expected for undergraduate students at a university. This presents the opportunity to perhaps examine this idea further with future research.

Conclusion

Recommendations for Dalhousie University

While Dalhousie University is a leader in environmental programs through courses offered in the College of Sustainability, the Faculty of Resource and Environmental Management, and the Department of Environmental Science, the university could do more to integrate climate change curriculum across all faculties. The Faculty of Architecture and Planning and the Faculty of Science seem to be adequately integrating climate change issues into

program curricula, however, we would recommend that the Faculties of Engineering, Arts and Social Sciences, Management, and Health Professions implement more emphasis on climate change into their programs. This could be as simple as ensuring that case studies or some connection to climate change impacts are briefly discussed and related to course materials. This recommendation should be easily applicable given the major implications climate change has for the Faculties of Engineering, Management, and Health Professions, as well as for departments in the Faculty of Arts and Social Sciences, such as international development and history. Further recommendations include a specified approach to enhancing students' climate change literacy and understanding aimed at dispelling widespread misconceptions about climate change, such as the relation of climate change to the ozone layer. While institutional curriculum is the main focus of this study, Dalhousie University could also develop more extracurricular events and options centred around climate change for students in faculties such as Health Professions, Engineering, and Arts and Social Sciences.

Recommendations for Further Research

Based on these results we recommend several paths of further research. Once Dalhousie University implements the aforementioned recommendations, it would be valuable to compare counts, percentages, and the ranking of faculties over the next 10 years. Quantifying results with these methods will allow for measured progress ranking. Assessing students across different majors would also be beneficial.

Repeating the study to aim for a higher response-rate would create a more representative view of the faculties assessed. Seeking to gain a higher response rate from the Faculty of Computer Science would also increase accuracy, as only three responses were received. This would generate a more complete and representative assessment of Dalhousie. On a larger scale, it would be beneficial to compare universities across Canada and internationally to determine how the level of understanding, awareness, and concern for climate change compares. Identifying specific institutions where improvements in climate change and environmental education can be made through more expansive research. Creating a knowledge base of how climate change education is being transmitted and received will improve our chances at a resilient future.

Acknowledgements

This research was accomplished through Dalhousie University in Halifax, Nova Scotia. Our team would like to acknowledge and thank Dr. Christopher Greene, and teaching assistant Navya Pandit, for their consistent advice, feedback, and encouragement during the process of this project. We would also like to thank Yvonne Ritchie for aid in the creation of graphs and charts, and for guidance in the use of excel. Finally, we would like to thank Dalhousie University faculty and staff for aiding in the distribution of the online survey, as well as all of the students that took the time to complete the survey.

References

- Anderson, A. (2012). Climate Change Education for Mitigation and Adaptation. *Journal of Education for Sustainable Development*, 6(2), 191.
- Arbuthnott, K. (2009). Education for Sustainable Development Beyond Attitude Change. *International Journal of Sustainability in Higher Education*, 10(2), 152-163. DOI: 10.1108/14676370910945954
- Bangay, C., & Blum, N. (2010). Education responses to climate change and quality: Two parts of the same agenda? *International Journal of Educational Development*, 30(4), 359–368. DOI: 10.1016/j.ijedudev.2009.11.011
- Cortese, A. D. (2003). The critical role of higher education in creating a sustainable future. *Planning for Higher Education*, 31(3), 15-22.
- International Council on Human Rights Policy. (2008). Climate Change and Human Rights: A Rough Guide. *International Council on Human Rights Policy*. Retrieved from http://www.ichrp.org/files/reports/45/136_report.pdf
- Lachapelle, E., Borick, C., and Rabe, B. (2014). Key Findings Report. *2013 Canada-US Comparative Climate Opinion Survey*. Retrieved from: <http://canada2020.ca/wp-content/uploads/2014/03/Canada-2020-Background-Paper-Climate-Poll-Key-Findings-March-3-2014.pdf>
- Loveday, E. (2015). Tesla Signs 5-Year Battery Research Deal With Dalhousie University. Retrieved April 09, 2017, from <http://insideevs.com/tesla-signs-5-year-battery-research-deal-dalhousie-university/>
- McMillan, E. E., Wright, T., & Beazley, K. (2004). Impact of a university-level environmental studies class on students' values. *Journal of Environmental Education*, 35(3), 19.
- Palys, T., & Atchison, C. (2014). Sampling and Recruitment. *Research Decisions: Quantitative, Qualitative, and Mixed Methods Approaches*, 5, 113-118. ISBN: 0176509372

Appendix A

Email to Department Heads/Administrators

To whom it may concern,

We are a small group of students in ENVS/SUST 3502, which is a class that centers around a group project and requires us to do a research project throughout the semester relating to sustainability at Dalhousie University. We were hoping you would be able to help us with our data collection for this project.

Without going into too much detail about the specifics of our project so as to protect the quality of the data we have collected, we have created a brief survey that should take about 10 minutes to complete. The survey mainly asks questions related to students' knowledge of climate change in their personal experience. All entrants will also have the opportunity to win a \$25 Tim Horton's gift card as a thank you for their participation.

We were hoping you would be able to distribute this survey via email to undergraduate students in your department/program:

<https://goo.gl/forms/5Gr8DLZPwsO9ij493>

We would be incredibly grateful for your help circulating this survey. Thank you in advance for your time and consideration.

All the best,

Jodi Butler, Michael Smith, Monica Mason, Jenny Boehner, and Christina Drebot

Appendix B

Survey Instructions and Survey Questions

Five students in Environmental Problem Solving Part II (ENVS 3502) are conducting a research study about students' understanding and awareness of climate change at Dalhousie University. If you are a current undergraduate student at Dalhousie University, you are invited to complete the short online survey below. The survey should take approximately 5-10 minutes and is completely anonymous. The survey will be open on March 21st, 2017, and will close on March 28th, 2017. There is a chance to win a \$25 Tim Horton's gift card to all respondents who fully complete the survey if their email address is provided. Only the students on this research team will have access and view the provided email, of which will not be included in the results of this study.

All responses to this survey will be saved on a secure survey program. Only the five students on the research team will have access to the raw data. Other students in ENVS 3502, the professor, as well as the teaching assistants, will only be presented with a summary of the results. You may withdraw from this research at any point while completing the online survey (by closing the browser), however, once the survey is submitted, because the surveys are anonymous, it will not be possible to retract your responses. The raw data will be deleted from the online survey program after April 10th, 2017; once the project deadlines for this research project have taken place.

The risks associated with this study are no greater than those you encounter in your everyday life.

We ask that you complete this survey completely, and as honestly as possible. By completing and submitting this anonymous survey, you are aware of and agree to the fact that your responses may be used and presented in the final report for this project, as well as may be presented to other students and faculty at Dalhousie University.

If you have any questions or concerns regarding this study, please feel free to contact envssustainabilitysurvey@gmail.com. Thank you for your help in conducting this research. To be entered for a \$25 Tim Horton's gift card, please enter your email address at the end of the survey.

1. Please indicate your faculty and major in the space below.

2. What year of your undergraduate degree are you currently completing?

___ 1

___ 2

___ 3

___ 4

___ 5 or more

3. Do you think the climate is changing?

yes no

4. If you answered “yes” to the above question: Do you think that climate change is due to human influence?

yes no

5. How well do you think you understand climate change?

Extremely well

Well

Moderately well

Not very well

Not at all

6. In your own words describe climate change in 2-3 sentences.

7. How concerned are you about human-made climate change in your everyday life?

Extremely Concerned

Concerned

Moderately Concerned

Somewhat Concerned

Not Concerned

8. Where does the majority of your knowledge related to environmental issues come from?

University classes

High school classes

Family and peers

News and social media

Other (please specify)

9. Please indicate the significance that the topic of climate change has in your academic program; extremely significant being a major topic, to no significance, being no mention of climate change.

Extremely significant

Significant

Moderately significant

Of little significance

No significance

10. Have you ever participated in any initiatives/societies/events etc. surrounding climate change and related issues?

yes no

11. Would you be interested in participating in any initiatives/societies/events Dal has, or has had, surrounding climate change and related issues if you were more aware and informed about them?

yes no

Please enter your e-mail address if you're interested in entering for a chance to win a \$25 Tim Horton's gift card.

Appendix C

Figures

Do you think the climate is changing?

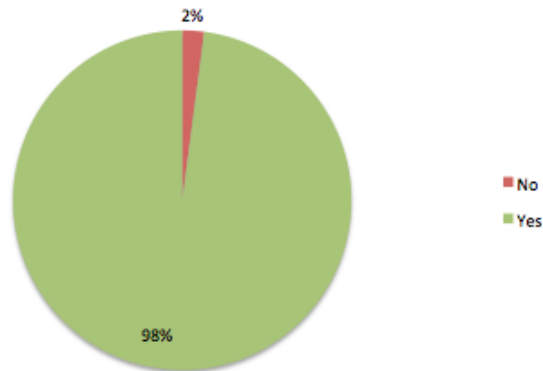


Figure 1. The proportion of students surveyed from Dalhousie University who believe the climate is changing and who do not believe the climate is changing (Question 3).

Do you think climate change is human caused?

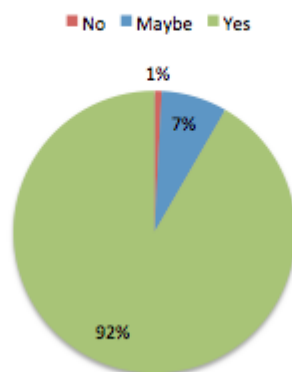


Figure 2. Breakdown of students surveyed at Dalhousie University who believe that climate change is human caused, who are unsure whether it is human caused, and who do not think it is human caused (Question 4).

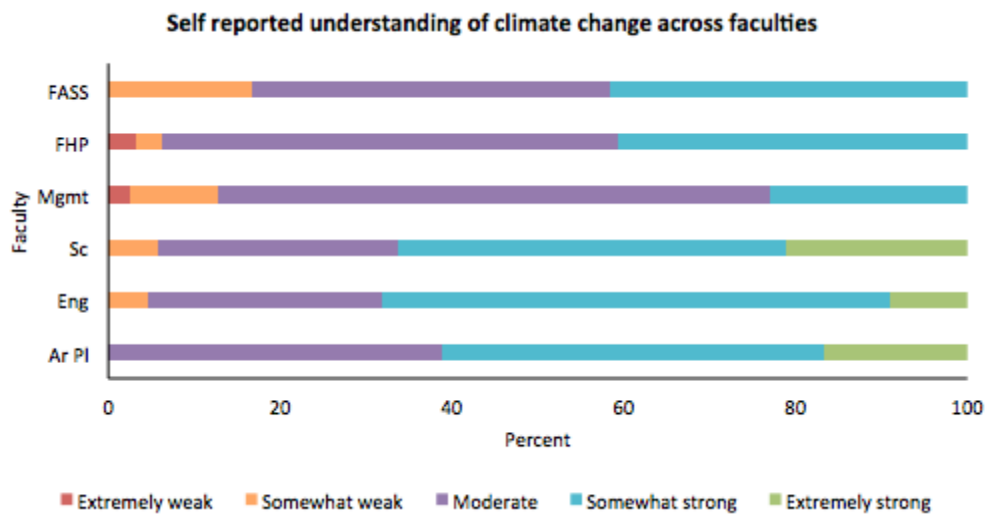


Figure 3. The proportions of self-reported understanding of students across different faculties at Dalhousie University (Question 5).

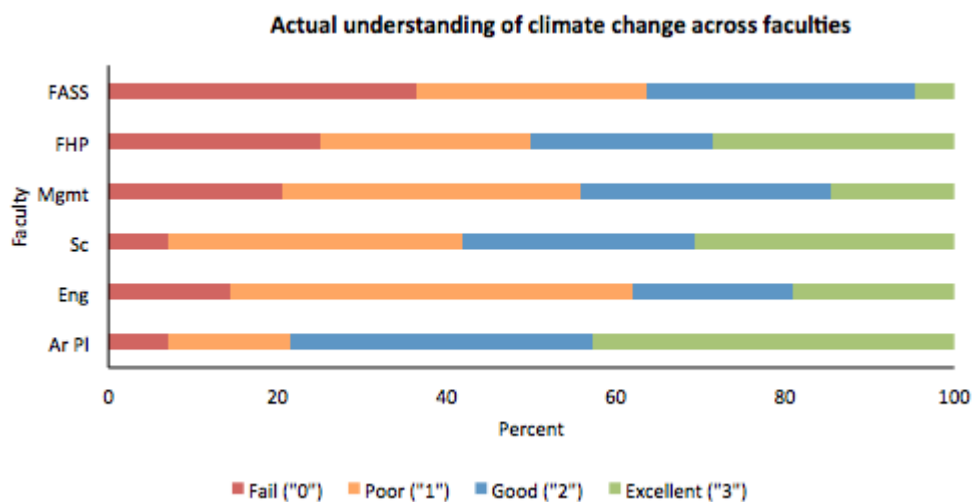


Figure 4. The proportions of actual understanding of students across different faculties at Dalhousie University (Question 6).

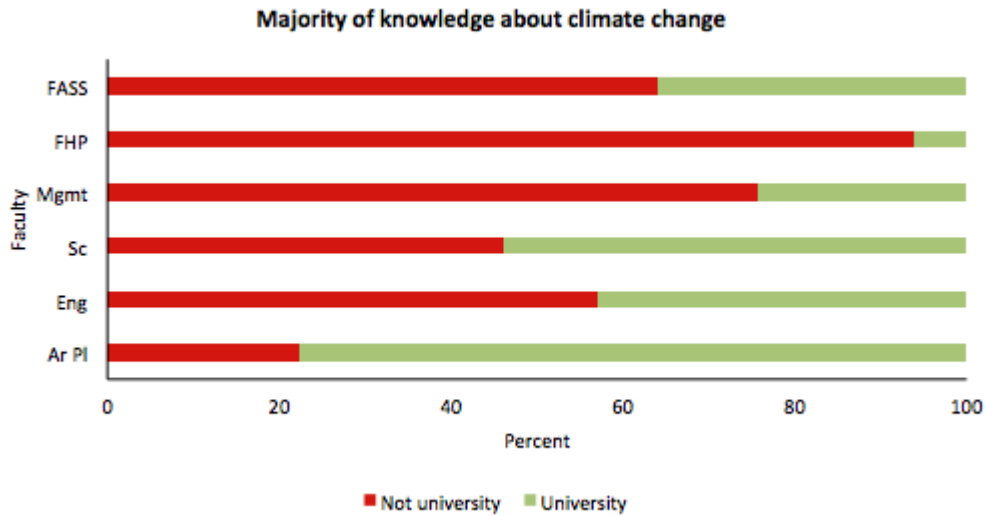


Figure 5. Shows the proportion of students in each faculty at Dalhousie University that claim the majority of their knowledge comes from university classes (Question 8).

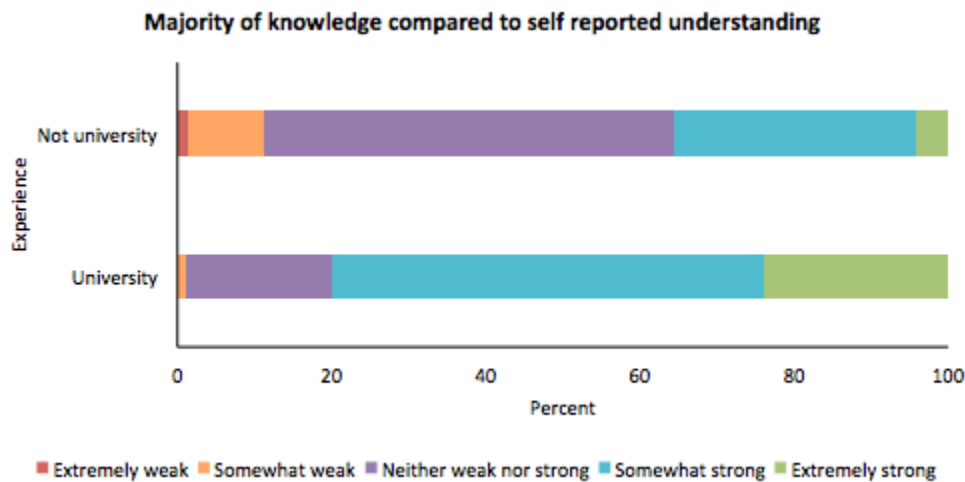


Figure 6. Students' perceived level of understanding around climate change compared to whether or not a student has received the majority of their climate change knowledge from university classes.

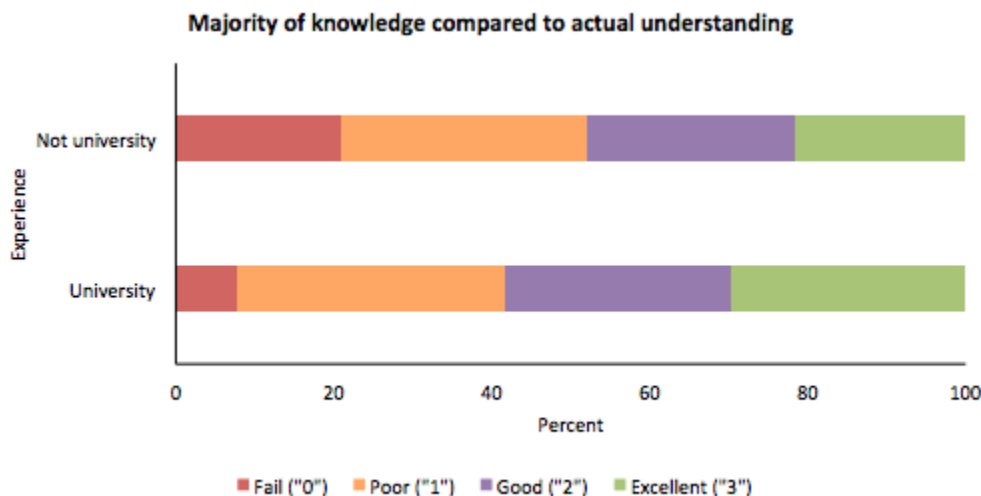


Figure 7. Students' actual level of understanding around climate change compared to whether or not a student has received the majority of their climate change knowledge from university classes.

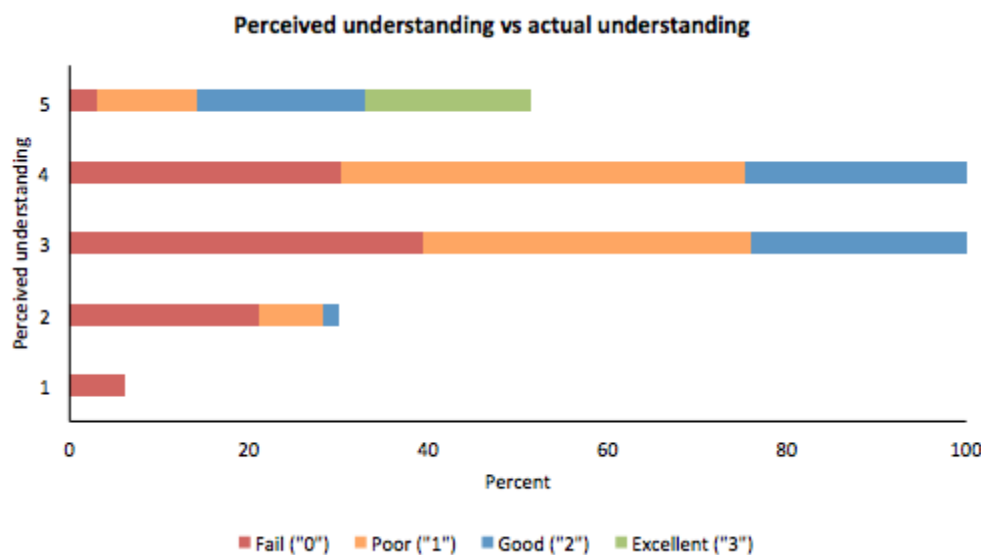


Figure 8. The levels of perceived understanding compared to actual levels of understanding surrounding climate change by students at Dalhousie University, where 1 is extremely weak, 2 is fairly weak, 3 is neither weak nor strong, 4 is somewhat strong and 5 is extremely strong.

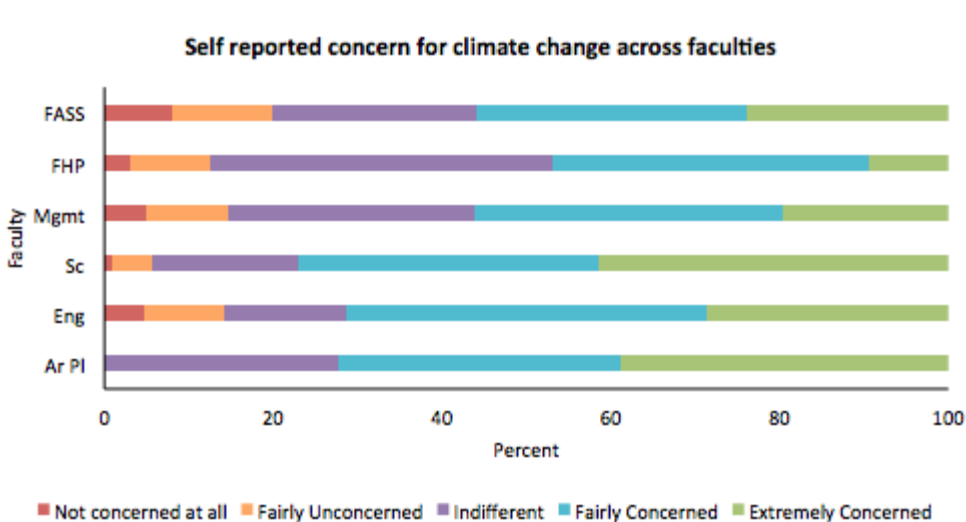


Figure 9. The self reported rates of concern from students across different faculties at Dalhousie University (Question 7).

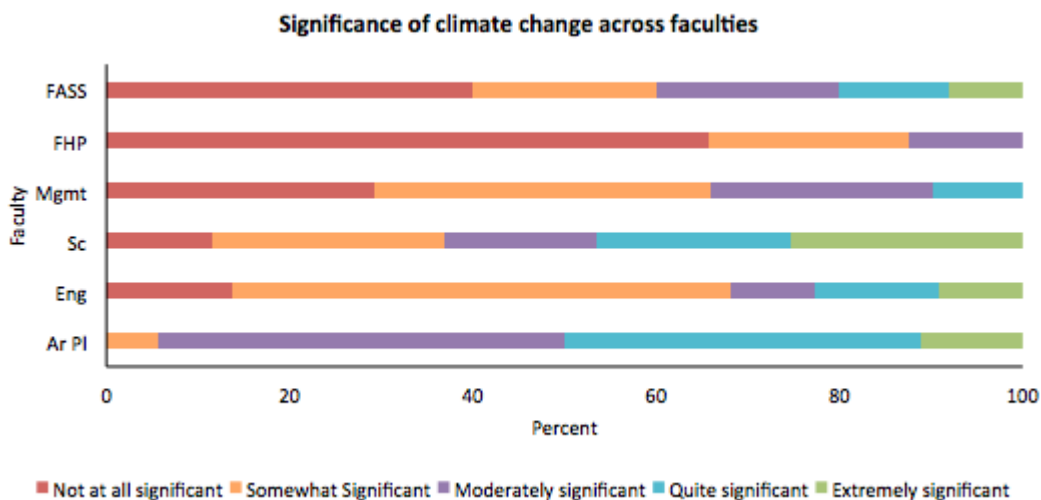


Figure 10. The significance of climate change according to faculty based on Dalhousie University students' self-reported views on their program (Question 9).

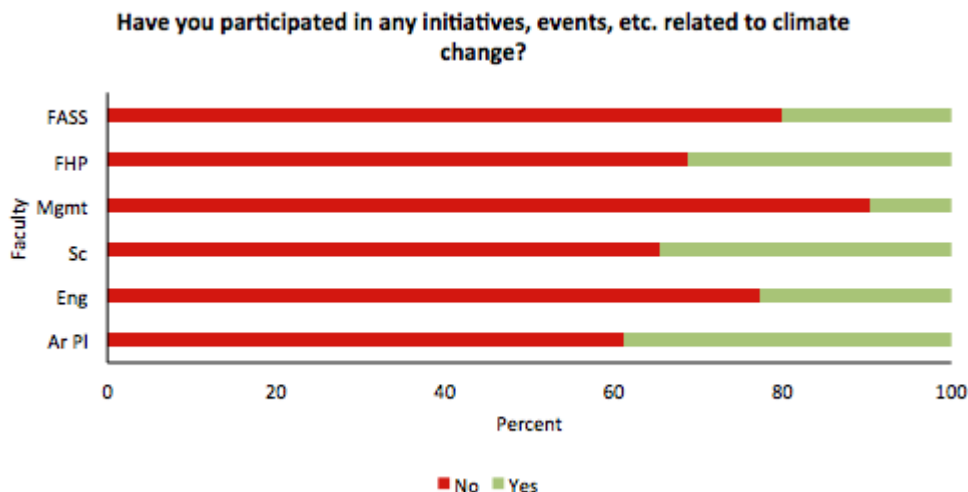


Figure 11. The percentage of Dalhousie University students who have and have not participated in events initiatives etc. related to climate change. It looks at the distribution across different faculties at Dalhousie University (Question 10).

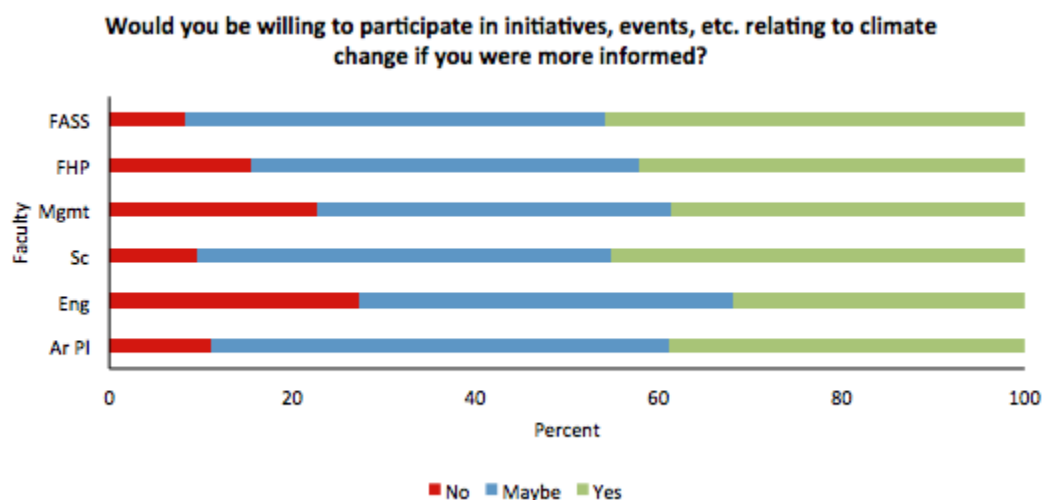


Figure 12. The percentage of Dalhousie University students who would be willing to participate in events initiatives, etc. related to climate change if they were more informed. The graph shows the distribution across different faculties at Dalhousie University (Question 11).

Mention of ozone layer in description of climate change

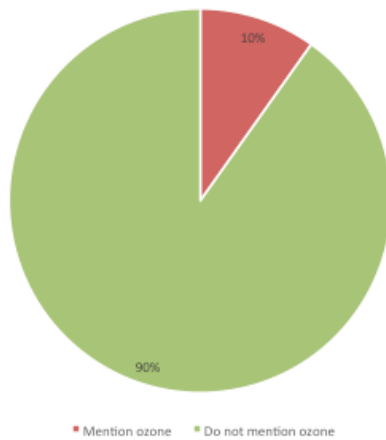


Figure 13. The proportion of students surveyed at Dalhousie University who discussed depletion of the ozone layer or mentioned ozone as a cause or factor of climate change in their description of climate change.

Survey respondents' year of study

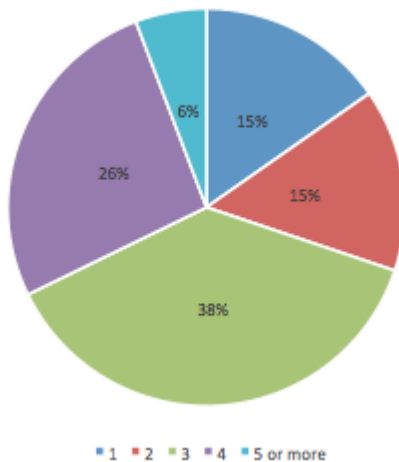


Figure 14. Breakdown of current year of study for the respondents of the survey.

Appendix D

Chi-Square Results

	Expected “Not at all – Not very well”	Observed “Not at all – Not very well”	Expected “Moderatel y well”	Observed “Moderatel y well”	Expected “Well – Extremely well”	Observed “Well – Extremely well”
Ar PI	1.339	0	6.992	7	9.669	11
Eng	1.636	1	8.545	6	11.818	15
FASS	1.860	4	9.711	10	13.430	11
FHP	2.380	2	12.430	17	17.190	13
Mgmt	3.050	5	15.926	25	22.025	11
Sc	7.736	6	40.397	29	55.868	69

Table 1. Chi-Square Test for Association by Faculty:

Q5: How well would you rate your understanding of climate change?

	Expected “0”	Observed “0”	Expected “1”	Observed “1”	Expected “2”	Observed “2”	Expected “3”	Observed “3”
Ar PI	2.183	1	4.560	2	3.789	5	3.468	6
Eng	3.275	3	6.839	10	5.683	4	5.202	4
FASS	3.431	8	7.165	6	5.954	7	5.45	1
FHP	4.367	7	9.119	7	7.578	6	6.936	8
Mgmt	5.459	8	11.399	12	9.472	10	8.67	5
Sc	15.284	7	31.917	34	26.523	27	24.275	30

Table 2. Chi-Square Test for Association by Faculty:

Q6: In your own words, describe climate change in two to three sentences (answers marked out of 3).

	Expected "1-2"	Observed "1-2"	Expected "3"	Observed "3"	Expected "4-5"	Observed "4-5"
Ar PI	1.793	0	4.257	5	11.950	13
Eng	2.091	3	4.967	3	13.942	15
FASS	2.49	5	5.913	6	16.598	14
FHP	3.187	4	7.568	13	21.245	15
Mgmt	4.083	6	9.697	12	27.220	23
Sc	10.357	6	24.598	18	69.046	80

Table 3. Chi-Square Test for Association by Faculty:

Q7: How concerned are you about human-made climate change? (Scale of 1-5)

	Expected "No"	Observed "No"	Expected "Yes"	Observed "Yes"
Ar PI	10.53	4	7.47	14
Eng	12.29	12	8.71	9
FASS	14.63	16	10.37	9
FHP	18.72	30	13.28	2
Mgmt	23.99	31	17.01	10
Sc	60.85	48	43.15	56

Table 4. Chi-Square Test for Association by Faculty:

Q8: Does the majority of your knowledge about climate change come from university classes?

	Expected "1-2"	Observed "1-2"	Expected "3"	Observed "3"	Expected "4-5"	Observed "4-5"
Ar PI	9.261	1	3.436	8	5.303	9
Eng	11.32	15	4.199	2	6.481	5
FASS	12.863	15	4.772	5	7.365	5
FHP	16.465	28	6.108	4	9.427	0
Mgmt	21.095	27	7.826	10	12.079	4
Sc	52.996	38	19.660	17	30.344	48

Table 5. Chi-Square Test for Association by Faculty:

Q9: Please indicate the significance that the topic of climate change has in your academic program. (Scale of 1-5).

	Expected "No"	Observed "No"	Expected "Yes"	Observed "Yes"
Ar PI	13.02	11	4.98	7
Eng	15.91	17	6.09	5
FASS	18.08	20	6.92	5
FHP	23.14	22	8.86	10
Mgmt	29.65	37	11.35	4
Sc	75.21	68	28.79	36

Table 6. Chi-Square Test for Association by Faculty:

Q10: Have you ever participated in any initiatives related to climate change?

	Expected "No"	Observed "No"	Expected "Maybe"	Observed "Maybe"	Expected "Yes"	Observed "Yes"
Ar Pl	7.29	9	2.53	2	8.18	7
Eng	8.91	9	3.09	6	10	7
FASS	10.12	11	3.51	2	11.36	12
FHP	12.96	19	4.5	7	12.55	6
Mgmt	16.6	17	5.76	10	18.64	14
Sc	41.12	33	14.61	7	47.27	64

Table 7. Chi-Square Test for Association by Faculty:

Q11: Would you be more interested in participating in initiatives related to climate change in you were more aware and informed about them?

Appendix E

Email Addresses for Survey Distribution

Faculty	Department	Email Address
Faculty of Arts and Social Science	n/a	sarah-jane.corke@dal.ca
Faculty of Arts and Social Science	n/a	sylvia.nielsen@dal.ca
Faculty of Arts and Social Science	Spanish	liliana.de.antueno@dal.ca
Faculty of Arts and Social Science	English	barkerr@dal.ca
Faculty of Arts and Social Science	Canadian Studies	ruth.bleasdale@dal.ca
Faculty of Arts and Social Science	Chinese Studies	sluo@dal.ca coordinator
Faculty of Arts and Social Science	Chinese Studies	rusn@dal.ca
Faculty of Arts and Social Science	Classics	Leona.MacLeod@dal.ca
Faculty of Arts and Social Science	European Studies	jerry.white@dal.ca
Faculty of Arts and Social Science	Gender and Women's Studies	m.denike@dal.ca
Faculty of Arts and Social Science	Geography	patricia.manuel@dal.ca
Faculty of Arts and Social Science	Geography	amryan@dal.ca
Faculty of Arts and Social Science	German	brigid.garvey@dal.ca
Faculty of Arts and Social Science	History	amal.ghazal@dal.ca
Faculty of Arts and Social Science	International Development Studies	mschnurr@dal.ca
Faculty of Arts and Social Science	International Development Studies	marian.mackinnon@dal.ca
Faculty of Arts and Social Science	Italian	paolo.matteucci@dal.ca
Faculty of Arts and Social Science	Philosophy	kirstin.borgerson@dal.ca
Faculty of Arts and Social Science	Political Science	parthur@dal.ca
Faculty of Arts and Social Science	Religious Studies	atreiger@dal.ca

Science		
Faculty of Arts and Social Science	Sociology and Social Anthropology	liesl.gambold@dal.ca
Faculty of Arts and Social Science	French	french@dal.ca
Fine Arts	n/a	marie.raynard@dal.ca
Engineering	Chemical Engineering	peasugrad@dal.ca
Engineering	Civil Engineering	civil.resource@dal.ca
Engineering	Electrical Engineering	elecdept@dal.ca
Engineering	Industrial Engineering	industrial.engineering@dal.ca
Engineering	Materials Engineering	peasugrad@dal.ca
Engineering	Mechanical Engineering	mech.admin@dal.ca
Engineering	Environmental Engineering	peasugrad@dal.ca
Faculty of Health Professionals	n/a	beth.weir@dal.ca
Faculty of Health Professionals	College of Pharmacy	pharmued@dal.ca
Faculty of Health Professionals	School of Health and Human Performance	jane.conrad@dal.ca
Faculty of Health Professionals	School of Health Administration	healthadmin@dal.ca
Faculty of Health Professionals	School of Health Sciences	irene.fitzgerald@dal.ca
Faculty of Health Professionals	Nursing	ashlee.hinchey@dal.ca
Faculty of Health Professionals	Occupational Therapy	helley.colbourne@dal.ca
Faculty of Architecture & Planning	Planning	tadlain@dal.ca
Faculty of Architecture & Planning	Architecture	susanna.morash@dal.ca
Faculty of Architecture & Planning	Architecture	arch.office@dal.ca
Faculty of Management	n/a	miriam.breslow@dal.ca
Faculty of Management	n/a	Florence.Tarrant@dal.ca
Faculty of Management	Commerce	Carrie.Hunter@dal.ca
Faculty of Computer Science	Computer Science	angie@cs.dal.ca
Faculty of Science	n/a	Joanne.Wells@dal.ca
Faculty of Science	Environmental Science	dhall@dal.ca
Faculty of Science	Biochem & Molecular Biology	chris.macneil@dal.ca
Faculty of Science	Math & Stats	admin@mathstat.dal.ca
Faculty of Science	Biology	julie.walker@dal.ca
Faculty of Science	Chemistry	cheryl.stanton@dal.ca
Faculty of Science	Dalhousie Integrated Science	disp@dal.ca

	Program	
Faculty of Science	Earth Sciences	Ann.Bannon@dal.ca
Faculty of Science	Earth Sciences	AMRyan@dal.ca
Faculty of Science	Economics	monique.comeau@dal.ca
Faculty of Science	Medical Sciences	medsci@dal.ca
Faculty of Science	Physics & Atmospheric Science	heather.ann.jennex@dal.ca
Faculty of Science	Microbiology & Immunobiology	c.anjowski@dal.ca
Faculty of Science	Microbiology & Immunobiology	mary.ellen.doolittle@dal.ca
Faculty of Science	Psychology & Neuroscience	Nancy.Gibbons@dal.ca
Faculty of Science	Psychology & Neuroscience	Leanne.Stevens@dal.ca
Faculty of Science	Oceanography	sharon.bellefontaine@dal.ca