Undergraduate students' climate change learning at Dalhousie University

By

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ABSTRACT

Behaviour change, influenced by a basis of climate change knowledge is an important way for individuals to mitigate climate change. This requires the presence of climate change education in Higher Educational Institutions (HEIs), though previous studies show that climate change education is not being thoroughly integrated into all faculties. To further investigate students' perception of their climate change learning at Dalhousie University, a Likert scale questionnaire was sent to all undergraduate students in their final year of study. Science faculties had comparatively high scores, while health faculties had comparatively low scores. Results indicate that students in certain programs don't believe they are learning enough about climate change and that students are not taking or are not offered many courses associated with climate change. There is a perceived inability and difficulty in scoping climate change into certain curriculums, a problem that cannot be solved individually but requires institutional change. There is a lot of growth potential in the climate change learning at Dalhousie University. Climate change is a transdisciplinary problem and can be integrated and contextualized into any faculty. This integration must be done imminently to increase student knowledge and address these gaps.

Key Words: Climate Change Learning, Climate Change Education, Faculty, Behaviour Change, Higher Educational Institutions, Perception

Chapter 1: INTRODUCTION

This thesis aimed to address the question; are students learning about climate change in their respective programs at Dalhousie University? Behaviour change, which is influenced by a basis of climate change knowledge is an important way for individuals to act against climate change. For the growth of climate change knowledge in students, there requires the presence of climate change education in Higher Educational Institutions (HEIs). Climate change is a topic that can and should be integrated into any program and faculty. It is one of the biggest problems of our time, and solutions to the climate crisis can only be found through a trans-disciplinary or interdisciplinary lens. Recent studies have shown that climate change topics are not always being integrated into every program of study, and more times than not are subjected to curriculums for physical sciences.

The purpose of this research was to investigate students' perception of their climate change learning in different faculties. Likert scale questionnaire data was collected at Dalhousie University among students in their final year of study from the undergraduate faculties and the College of Sustainability, and a quantitative analysis was performed to discern findings.

The Faculty of Sciences, Agriculture and the College of Sustainability had comparatively high scores, while the Faculty of Health and Dentistry had comparatively low scores. Given all the health implications associated with the climate crisis it is surprising that health faculties had such low scores. This is attributed to an inability and uncertainty in the inclusion of climate change education in the curriculum rather than the perceived unimportance, as seen in previous studies. Lower knowledge scores indicate students don't believe they are learning enough about climate change in their programs. Lower scores for curriculum questions indicate that students are not taking or are not offered many courses associated with climate change. This is something that is difficult to change on an individual scale and requires institutional change. Higher scores for integration questions indicate that core curriculum requirements are not a necessity to have higher climate change integration in course content.

This thesis paper begins with an Introduction that highlights the connection between climate change learning and behaviour change and reviews the background information on climate change learning in HEIs. The purpose and objectives of this study will be reiterated, and previous research in this field will be shared in the Literature Review. The Methods section further

explains the administration and collection of survey responses as well as the quantitative analysis. The Results & Discussion section reviews all the findings gathered by the data and explains in detail the themes of the findings and what can be taken from this research. There are a number of gaps and a lot of growth potential in the climate change leaning at Dalhousie University. Readers will have a better understanding of students' perception of the climate change learning in different faculties and what needs to be done to improve climate change integration at Dalhousie University.

1.1 Background

When combating climate change, one of the biggest implications is behaviour. Behaviour change is largely studied as one of the most profound and influential ways for individuals to mitigate climate change (York et al., 2021, Muroi & Bertone, 2019). Behaviour change, at its core, is influenced by a basis of climate change knowledge and awareness of climate change issues (Kolenaty et al., 2022, Muroi & Bertone, 2019). This requires the presence of climate change education in Higher Education Institutions' curriculums and across all programs (Molthan-Hill et al., 2021, Padhra & Tolouei, 2023).

1.1.1 Higher Educational Institutions and Climate Change Education

In most countries HEIs are one of the largest outlets for learning (Ahmad, 2015). In HEIs, students chose a program to complete their degree and that program is tied back into faculties; the main overarching branches that split up schooling institutions. Faculties have different teaching methods and curriculums depending on the program to allow students to get a more specialized education. HEIs are incredibly important in the forming and changing of attitudes and perspectives on climate change (Fernández-Manzanal et al., 2007, Rolleston et al., 2023). HEIs have an essential role in the evolution and transformation of societies as they educate future leaders and decision makers (Taleb et al., 2021, Leal et al., 2021, Rolleston et al., 2023). The education that students receive at HEIs implores them to understand climate change issues and equip them to critically problem solve (Leal et al., 2023, Fernández-Manzanal et al., 2007).

HEIs have an extreme power and influence in how and what they teach students about climate change (Ewert & Baker, 2001, Fernández-Manzanal et al., 2007, Taleb et al., 2021, Rolleston et al., 2023). Covering climate change topics in HEIs can massively impact and

influence students by providing foundational knowledge and skills (Rolleston et al., 2023, Centre for Educational Research and Innovation, 2021). Climate change knowledge is the foundation for climate change action, and that knowledge can be translated to pro-climate behaviours, attitudes, and higher self-efficacy (Kolenaty et al., 2022, Muroi e al., 2019, Stubbs et al., 2018). Climate change, being such a globally impactful and relevant topic, should therefore be utilized in HEIs curriculums and teachings (Leal et al., 2021, Padhra & Tolouei, 2023).

Climate change education has become more prevalent since the Paris Agreement, in 2015, articulated Articles 11 and 12 and called for the commitment of the implementation of climate change education in school curriculums (Molthan-Hill et al., 2021, Coleman & Gould, 2019, Padhra & Tolouei, 2023). Yet, it is only in the last few years that national climate change education plans have been devised (Nelson et al., 2022), and even then, these plans tend not to be developed past high school education systems (Padhra & Tolouei, 2023). There have been great leaps in the inclusion of climate change education in elementary and high school educational institutions (Centre for Educational Research and Innovation, 2021). Universities, for the most part, have only begun to recognize their responsibility to develop and implement climate change modules in educational content (Leal et al., 2021).

Climate change is a global problem, and it effects a wide range of disciplines, so should therefore be studied with an interdisciplinary lens (Leal et al., 2021, Molthan-Hill et al., 2021, Pharo et al., 2021, Stubbs et al., 2018, Padhra & Tolouei, 2023). Climate change as a topic should not be subjected to science departments, rather it needs to be implemented at the institutional level (Leal et al., 2023). Climate change is a multidisciplinary problem, that requires input and knowledge from all faculties and programs (Tolppanen et al., 2022, Padhra & Tolouei, 2023).

Different disciplines have strengths that correlate with mitigation and adaption efforts for the climate crisis (Molthan-Hill et al., 2021). Failing to mitigate and adapt to climate change is a societal problem, and not something that can be solely resolved by physical scientists (York et al., 2021). Social and behavioural sciences play a massive role in shaping climate knowledge and illuminating the multifaceted social dilemmas that arise from the threat of climate change (York et al., 2021, Yearly, 2009. Pharo et al., 2012).

1.1.2 Behaviour Change and Climate Change

Behaviour change is a required component for tackling climate change, but it is not solely dictated by one facet such as knowledge (Molthan-Hill et al., 2021, Vaughter, 2016). Behaviour is cultivated through attitudes, perception, and actions (Fernández-Manzanal et al., 2007, Leal et al., 2023, Centre for Educational Research and Innovation, 2021, Kolenaty et al., 2022) with knowledge being the key initial driver of the whole process (Kolenaty et al., 2022, Padhra & Tolouei, 2023).

It is not education and knowledge accumulation that fosters positive environmental behaviours directly, rather it's a combination of influences such as social integration, values, environmental stewardship, environmental identities, motivations, and willingness to act (Nelson et al., 2022, Centre for Educational Research and Innovation, 2021, Kolenaty et al., 2022). All these influences stem back to base climate change knowledge as the initial step needed in the process of behavioural change (Kolenaty et al., 2022, Vaughter, 2016).

Climate literacy, acquired in educational settings, creates the base layer of knowledge for students to develop their climate concern, self-efficacy, willingness to act and willingness to have climate-protective behaviours (Kolenaty et al., 2022). HEIs can majorly influence attitudes and perceptions on climate change and therefore have an influence on behaviour and behaviour change (Leal, et al., 2023, Molthan-Hill et al., 2021, Rolleston et al., 2023).

Everyone perceives climate change in similar ways, whether it's as a threat, an uncertainty, or a phenomenon (Valkengoed et al., 2023), yet we don't always talk about climate change in the same way. Communication and knowledge representation is extremely different depending on a person's field, and these representations play a role in how climate change is discussed (Yearly, 2009, Ahmad et al., 2015). Climate change is such a versatile topic, something that can be related to almost anything, and should therefore have no problem being introduced and incorporated into different disciplines, though we have seen that is not always the case (Molthan-Hill et al., 2021, Kolenaty et al., 2022, Muroi & Bertone, 2019, Hess & Collins, 2018).

1.2 Purpose

The purpose of this study was to investigate students' climate change learning in their respective faculties. It investigated if students perceive they are learning about topics of climate change in their core curriculum and further if topics of climate change are being contextualized in course content. This study aimed to investigate students from all undergraduate faculties at

Dalhousie University, including the College of Sustainability, because every program is somehow related to and impacted by climate change (Leal et al., 2021, Leal et al., 2023, Padhra & Tolouei, 2023). A simple analysis of a program's core curricula would easily answer if students were learning about climate change in their programs, but this study aimed to target students' perceptions of what they are learning, since perceptions can be a representation of how the student has conceptualized the subject (Munoz-carrier et al., 2020). Findings were discerned through a quantitative analysis to gain insight into the climate change learning in respective departments of faculty. I expected to see differences in perceived climate change learning between faculties and I aimed to compare responses between faculties against each other.

1.3 Research Question & Objectives

The research question I sought to answer was 'Are students learning about climate change in their respective programs at Dalhousie University?'. The objectives are threefold: determine if students perceive they are learning about climate change in their programs, determine if students perceive that climate change topics are included in their programs' core curriculum and determine if topics of climate change are contextualized in course content.

1.4 Research Design

The collection of data for this study was done through a survey released to students in their final year of their undergraduate degree. The survey allowed for a large sample of students to be reached from all undergraduate faculties at Dalhousie University. This survey aimed to collect students' perceptions of the integration of climate change topics in their program. Students in their final year of schooling were targeted, as these students have been in their program for multiple years, have participated in the majority of their programs core courses and will have a more holistic perception of climate change topics included in their program. A previous study done on climate change and university programs showed that in later years of schooling students tend to be more cognisant of how their topic of study fits into the world and present more environmental concern (Fernández-Manzanal et al., 2007).

For the design of this study, I developed several questions, with inspiration from previous studies, to investigate students' perception on the topic of their own climate change education. Questions were adapted to focus on climate change learning in students' programs, the degree to

which these climate change topics have been included in core curricula and if climate change topics are contextualized in course content. I used a Likert scale in the survey to allow for easy data analysis. Survey participants were completely anonymous, with the only point of identification being the specification of their faculty.

1.5 Significance of Study

Climate change is not a scientific problem, rather it is a social problem (Fine & Love-Nichols, 2021), and behaviour change is an essential antidote for the climate crisis (York et al., 2021). To understand how to move towards behaviour change it is essential to understand people's base knowledge of climate change. This base knowledge, although it can have many origins, is more times than not established and cultivated in educational settings. The complexity of climate change requires a multi-disciplinary approach and HEIs provide the perfect platform for this undertaking (Padhra & Tolouei, 2023).

As Taleb et al (2021) wrote; "Education can be a catalyst that changes people's behaviours." It is therefore essential to have an idea of what people are learning in their studies, but more importantly how they are perceiving that leaning. An undergraduate's general education tends to be very broad and shapes their future, so improving the undergraduates' educational curriculums to include climate change will benefit students' long term (Stubbs et al., 2018). It is important to understand students' perceptions about climate change in their university career because it will go on to greatly impact their behaviour in relation to climate change.

Investigating if students perceive they are leaning about climate change, if that learning comes from their programs core courses and if climate change content is being contextualized in course content at Dalhousie University is an essential step in working towards behaviour change. All faculties differ in their teaching methods and content, but climate change is an integral part of that content no matter the discipline. It is essential to understand if programs include climate change in their curriculum and if students perceive that they are learning about climate change.

Chapter 2: LITERATURE REVIEW

Research has shown that behaviour change is one of the most impactful ways individuals can fight climate change (York et al., 2021). Behaviour change is multifaceted and has many influences, from attitudes, perceptions, stewardship, values, and willingness to act (Leal et al., 2023, Kolenaty et al., 2022, Nelson et al., 2022). Above all else, behaviour change, and its influences require a base climate change knowledge to be the key driver in the behaviour change process (Kolenaty et al., 2022, Padhra & Tolouei, 2023).

The purpose of this review was to analyse climate change knowledge representation as it presented in HEIs. This review of the existing research on climate change education in HEIs further assess' how it was integrated into different faculties and the narratives on inclusion in core curriculums and contextualization.

2.1 Climate Change Education at HEIs

Climate change education is the provision of foundational knowledge and skills to help students analyse and overcome environmental challenges, raise awareness of the issue, and help to shape attitudes about climate change (Centre for educational research and innovation, 2021). It is an essential part of the educational system because it is inherently an interdisciplinary subject that provides students with knowledge that is applicable across many fields of study (Leal et al., 2021, Molthan-Hill et al., 2021, Padhra & Tolouei, 2023).

Studies have shown the importance and relevance of climate change education inclusion in school systems and HEIs. The knowledge gained from such institutions can be translated into pro-environmental behaviour, shifts in attitudes toward climate change and higher self-efficacy (Kolenaty et al., 2022, Muroi et al, 2019), not to mention all the skills that can be developed from such an interdisciplinary subject (Centre for educational research and innovation 2021, Kolenaty et al., 2022, Nelson et al., 2022). HEIs are well positioned to include and distribute climate change education tools and efforts, as well as capitalize on the training and education for a new green sector workforce (Leal et al., 2023, Padhra & Tolouei, 2023), but there are mixed results on HEIs integration of climate change education.

Unfortunately, recent research has shown that climate change education is not always thoroughly integrated into curriculums and institutions at HEIs (Padhra & Tolouei, 2023).

Molthan-Hill et al (2021) found that references to climate change and the contributions of different disciplines to mitigation and adaption actions are far and few between. Kolenaty et al (2022) and Muroi & Bertone (2019) found that there are substantial climate change knowledge gaps in youth, and misinformation on climate change causes. Hess & Collins (2018) analysed the general core curriculum of 100 of the top universities in the United States and found the probability of student taking at least one climate change course through the core curriculum of their program is 0.17 across all universities in the study.

Recent years have seen an explosion of climate change education research, especially after the push for commitments to the implementation of climate change education in school systems at the Paris agreement in 2015 (Molthan-Hill et al., 2021). The sufficiency of this climate change education is a key driver in climate change action (Kolenaty et al., 2022, Padhra & Tolouei, 2023) and should therefore be treated with urgency.

A number of studies have done a review of how climate change education is being handled at HEIs (Leal et al., 2021, Rolleston et al., 2023, Hess & Collins, 2018, Vaughter, 2016) and the knowledge that comes out of climate change educational courses (Tolppanen et al., 2022, Kolenaty, 2022). Many HEIs have included climate change education in their institution's offerings and resources.

Surveys on the efficiency of the climate change education received and pursued at HEIs indicate that students are not always presented the opportunity for further climate change education (Leal et al., 2021). Although lack of funding did present some issues, the main needs established were for more integration of climate change topics into already designated courses, or the creation of new interdisciplinary courses (Leal et al., 2021).

Student's perception on how their HEI is handling climate change education, collected through a survey, showed low satisfaction (Rolleston et al., 2023). There was also a narrative that the institutions should be doing more in relation to climate change, on both an institutional level and curriculum level (Rolleston et al., 2023). A separate study found that despite there being climate change education offered, students continue to feel ill-equipped with their knowledge and education around climate change (Hohenhaus et al., 2023)

A study on student's climate literacy levels showed that there are substantial knowledge gaps in terms of climate change, as well as high levels of misconception on climate change causes (Kolenaty et al., 2022). Surveys on how student's knowledge, values and worldviews had

changed showed that there was an increase in knowledge and pro-environmental behaviour through student's participation in a climate change course (Tolppanen et al., 2022).

In a study from 2018, a core curriculum analysis was taken of the top 100 universities in the United States to determine the proportion of courses that included climate change topics (Hess & Collins, 2018). Results showed that there was a low probability of students taking a climate change course via their curriculum, and furthermore there was very little integration of climate change topics into existing courses, rather they are made to be courses separate from the programs subject (Hess & Collins, 2018). Selective exposure bias was also highlighted as an issue in climate change education analyses where climate change courses are not included as part of the core curriculum of programs (Hess & Maki, 2019, Hess & Collins, 2018).

2.2. Inclusion of Climate Change Topics in Different Programs

Climate change topics, for too long, have been viewed as a science issue, something for biologists and climate scientists to worry about. This has led to people not having basic knowledge on the occurrence of climate change, which leads to misconceptions and knowledge gaps about climate change (Kolenaty et al., 2022, Muroi & Bertone, 2019). Climate change education does not necessarily have to be a science class. There are multitudinous ways to incorporate climate change education into programs and courses (Leal et al., 2023, Padhra & Tolouei, 2023).

Recent studies have outlined the needs for climate change education related to courses, either by introducing into existing courses, or designing new interdisciplinary courses (Leal et al., 2021, Stubbs et al., 2018). Variations in the presence of climate change education in different programs has been identified as an issue because sustainability and climate change curricula tend to be presented in narrow scopes, more times than not as an ecological problem (Coleman & Gould, 2019, Molthan-Hill et al., 2021), or as a separate entity to the core curriculum (Hess & Collins, 2018).

2.2.1 Inclusion of Climate Change Topics in Core Curriculum

The core curriculum in higher education institutes varies between faculties and highlights the essential courses for specific programs. Studies have shown that if climate change topics are integrated into HEIs, they do not tend to be integrated into the core curriculum of programs (Leal

et al., 2021, Hess & Collins, 2018). Climate change education occurs frequently in science-based programs, such as environmental and sustainability studies, and even then, is not required in programs core curriculums (Hess & Collins, 2018). This also insinuates that the people taking these courses sought out that topic and are likely already driven to learn more about climate change, while students with confirmation bias and selective exposures bias avoid those courses (Hess & Collins, 2018, Hess & Maki, 2019).

There is need for core curriculum reform to introduce a more flexible and interdisciplinary curriculum that addresses climate change as a main focal point in any course (Leal et al., 2021). The integration of climate change education into multitudinous different programs have been tackled in numerous recent studies (Leal et al., 2023, Coleman & Gould, 2019, Leal et al., 2021, Molthan-Hill et al., 2021, Padhra & Tolouei, 2023, Stubbs et al., 2018, Pharo et al., 2012) and have demonstrated that the integration of climate change education and sustainability into other disciplines is possible and necessary. Some examples, such as the KTH Royal Institute of Technology and the University of Campinas, have included the integration of climate change education in all levels of educational programs (Leal et al., 2021). The University of Vermont has recently integrated new sustainability course requirements for undergraduates and have further proposed that courses, no matter the discipline, address sustainability and ESG requirements (Coleman & Gould, 2019).

2.2.2 Climate Change Contextualization in Course Content

Contextualizing climate change education to the specific program or subject will enable better understanding and build perspective in terms of student's interests (Padhra & Tolouei, 2023). There is a need for climate change education to be embedded into existing courses from any program to allow for that contextualization (Leal et al., 2021, Leal et al., 2023, Padhra & Tolouei, 2023).

HEIs tend to present climate change knowledge in narrow disciplinary silos (Coleman & Gould, 2019). In many ways, this could be attributed to the inability to conceptualize how to implement climate change into a program. The way climate change is discussed and associated between respective programs is extremely different. There must be various integration methods depending on the audience for the course content and their background (Fine & Love-Nichols, 2021). The representation of climate change education requires serious thought because it’s

representation in course content impacts students' comprehension and applicability of their learned knowledge.

Padhra & Tolouei (2023) investigated the potential integration of climate change education into HEIs, specifically into all 61 of the existing programs at a university. They prove that the embedment of climate change topics into course structure and content can be tailored to any program (Padhra & Tolouei, 2023). This study also emphasizes the need to contextualize climate change education to the subject of a course, as this enables students to better understand and perceive it from their field of study (Padhra & Tolouei, 2023).

A study on mitigation and adaption in education shows that different disciplines of study have different areas where they excel, but all of which can be attributed and included in fighting climate change through mitigation and adaption efforts (Molthan-Hill et al., 2021). Unfortunately, many disciplines at university rarely reference or attribute to climate change, much less in the dialogue of mitigation and adaption (Molthan-Hill et al., 2021).

2.3 Common Themes in Climate Change Education

Through much of the climate change education research done in previous years, common observations express that it is not enough, and that further curriculum reform is necessary (Leal et al., 2021, Hess & Collins, 2018). Although institutions may recognize the problem, curriculum changes are slow to occur, indicative of institutions prioritization of the issue (Hess & Collins, 2018). Hess & Collins (2018) also highlighted that often major changes to the curriculum come from administration rather than the faculty itself.

Climate change education has begun to be integrated into HEIs, some more successfully than others. The research shows that the inclusion of climate change topics into curriculum is beneficial and necessary, but HEIs have been slow to include sufficient content in all faculties of study. There is a need for curriculum reform on a broad scale, but it first needs to be understood where the curriculum gaps are on an individual university scale. To optimize a program's teachings, one must first understand the nature of the program teachings (Hohenhaus et al., 2023).

2.3.1 Climate Change Education Measurement

There are several studies in recent years that investigate climate change education at Universities and HEIs. Although several strategies and tools have been utilized, the most common is surveys (Leal et al, 2021, Tolppanen et al, 2022, Rolleston et al, 2023), and core curriculum analyses (Coleman & Gould, 2019, Hess & Collins, 2018). A multi-tiered approach to climate change education research has been utilized, including a combination of tools such as a literature review, a survey and case studies (Leal et al, 2021). The goal of climate change education surveys varies widely: from focusing on the efficiency of the climate change education at their institute (Leal et al, 2021), climate change knowledge fluctuations (Tolppanen et al, 2022), climate change education sufficiency for behaviour change (Kolenaty et al, 2022) and students' perception of the climate change education they are receiving from their HEI (Rolleston et al, 2023).

The majority of surveys utilized for climate change education analyses are a Likert scale of some sort, typically ranging from strongly disagree to strongly agree. Likert scales are suitable for collecting students' perception of their climate change education as it provides a solid scale and has proven to have good reliability and validity (Fernández-Manzanal et al., 2007, Rolleston et al., 2023). This tends to be a strong way to determine adequacy, opinions, and perceptions of climate change education within HEIs (Rolleston et al, 2023, Nelson et al., 2022, Muroi & Bertone 2019, Fernández-Manzanal et al., 2007). Previous surveys have acquired inspiration from questions of previous studies and questions have been sectioned to allow for specific data analysis (Tolppanen et al., 2022, Kolenaty et al., 2022).

Climate literacy is the conceptualization and awareness of the impact of climate change on humans and the role that humans play in exasperating the climate crisis (Kolenaty et al., 2022). Climate literacy is conceptualized into a three-pronged approach; Knowledge, skills, and behaviour (Kolenaty et al, 2022). Student climate literacy was quantified through a survey by Kolenaty et al (2022) that separated their questions into categories of knowledge, concern, self-efficacy, and willingness to act. The wording of the survey was inspired by previous studies and further validated before distribution (Kolenaty et al, 2022). Tolppanen et al (2022) also separated their questions into four distinct categories; knowledge, values, worldview, and willingness to act.

Students' perception of their climate change educations was analysed as part of a wider study done between universities in Brazil, Fiji and Kenya in the Climate-U project by Rolleston

et al (2023), through examination of undergraduate students' attitudes and experience in relation to climate change and their university. The survey used a Likert scale and included questions that distinctly asked about the adequacy of climate change inclusion in students' academics and students' satisfaction in their climate change learning (Rolleston et al. 2023).

Climate Capability is a way to measure the possibility of citizens making meaningful change through climate action by being educated, motivated, and empowered to make behaviour change (Horry et al., 2023). Based on the idea of carbon capability; the ability to meet carbon reduction requirements through lifelong lifestyle changes, the 24-item Climate Capability Survey (CCS) aims to capture peoples' understanding, motivation, willingness to act and the appreciation of necessary systematic change required for tackling climate change (Horry et al., 2023). The results were analyses on a subscale and comparisons were made between adolescents and adults (Horry et al., 2023).

2.4 A Study of Perception

It is likely that climate change topics have been discussed or interwoven into course content in most programs, whether it is explicitly stated in course curriculum or not. People may not even realize they are discussing climate change in their course, especially if it is not explicitly mentioned. Perception may be influenced by the individual interpretation of the speaker of a course (Hahnel & Brosch, 2016). So, although it is important to explicitly have climate change education incorporated into courses and programs, it is also important to understand if students perceive they are learning about climate change in their programs.
It tends to be that people who are worried about climate change are more likely to deem their existing knowledge to be insufficient and require more knowledge and education about climate change to feel well equipped (Yang et al., 2015, Hohenhaus et al., 2023). It is important for educators and institutions to understand how students' perceptions can be swayed and can shift based on the information given to them (Munoz-carrier et al., 2020). Effectively reaching students requires an understanding of their perception of climate change learning in the first place.

Students' perception of the climate change knowledge they are exposed to may not line up with what is explicitly stated in course curriculums because students require climate change to be communicated in a way that they can relate to (Munoz-carrier et al., 2020). Just because

climate change topics are mentioned in a course, if they aren't related to or connected with the students interests or field of study, students may not perceive the information as important or relevant to them. This is why it is essential not only to have climate change courses, but also to integrate climate change knowledge into different established courses so that it can be explicitly contextualized to the students' studies (Padhra & Tolouei, 2023).

2.5 Summary

The benefits and importance of including climate change education in all programs has been highlighted. Analyses of HEIs that included climate change topics in their curriculums have shown both positive and negative results. There is tremendous benefit to including climate change education in HEIs curriculums as a way to provide base climate change knowledge and help students develop their own opinions, attitudes, and perceptions of climate change. Although there are mass amounts of research pertaining to the importance and feasibility of incorporating climate change topics into all faculties, there remains a failure of HEIs to incorporate these topics into existing curricula.

To bring about change in this system, it is important to understand where we stand on a smaller scale; focusing on the climate change education students perceive they are receiving from an individual university.

Chapter 3: METHODS

An online Likert scale questionnaire was distributed to students in all undergraduate faculties at Dalhousie University. Questions were associated with climate change learning, climate change core curriculum and climate change integration in course content. A quantitative analysis was performed to discern results from the findings.

3.1 Population and Sample

The population represented through this study was undergraduate students at Dalhousie University who were in their final year of study. This study aimed to reach students from all faculties at Dalhousie that represent undergraduate students. Students from the Faculty of Agriculture, Architecture & Planning, Arts & Social Sciences, Computer Science, Dentistry, Engineering, Health, Law, Management, Medicine, and Science were sought after to be subjects in this study.

Communication officers for each faculty at Dalhousie University were contacted to distribute the survey to students in their final year of their undergraduate degree. Only students in their final year of undergraduate were requested to participate in this study. Students in their final year of schooling were targeted, as these students had been in their program for multiple years, had participated in the majority of their programs core courses and had a more holistic perception of climate change topics included in their program. There were no concrete numbers as to how many final year students were in each faculty, so there was no quota for the sample size necessary for each faculty.

Emails were sent out to the communications officer of each faculty to request that the survey and brief message be sent out to the subscribed undergraduates for each faculty. Upon contact with the officer of communications for each faculty and department, the survey was sent out to undergraduate students in respective programs. Email requests to participate in the study included linked access to the online questionnaire. Consent was documented on the first page of the online survey. The participants' act of completing and submitting the survey was used to indicate consent.

This survey was completely voluntary and took two minutes to complete. Although the survey was sent out to students from all years of study, it was explicitly stated that the survey is only

interested in students in their final year of study. To mitigate any risks while sampling the population, the survey requested confirmation that the student is in their final year of study. I did not seek to clarify 'final year of study' any further than this and left it up to students' own perception of if they are in their final year.

3.2 Survey Design and Administration

The data used in this study was collected through an online survey that was distributed to faculties in January and data was collected until mid-February. Participants were contacted through their Dalhousie email from the respective officer of communication for each faculty. Students were given approximately 30 days to complete this two-minute digital survey that was hosted on the platform Opinio: Dalhousie's recommended survey software application.

In the email containing the survey link, the survey was described as a tool to better understand student's climate change learning in different faculties. Completion of the survey was voluntary and anonymous, with the only identifying information being student's department of faculty to preserve the anonymity of survey participants.

The survey consisted of two sections: The first asking participants to identify their department of faculty, and the second asking participants to respond to eight statements on a five-item scale. The scale ranged from 'Strongly Disagree' to 'Strongly Agree' and included an option for 'prefer not to answer'. The eight statements were devised to target 3 topics: student's climate change learning, inclusion of climate change topics in core curriculum and climate change contextualization in course content. The questions used in this study are listed in Appendix A. I chose not to include a definition of core curriculum and left it up to students' perceptions of what their core curriculum might be, especially considering the array of faculties I was reaching, and that core curriculum may present differently in different programs.

3.3 Data Analysis

A quantitative comparison analysis was performed to investigate the relationship between faculty and climate change learning responses from the survey. Participants' responses to the survey statements were sorted by faculty. The responses that were incomplete or indicated that the student was not in their final year of study were removed from the dataset. The responses on a Likert scale were transcribed into numbers so as to easily determine the average response.

Responses were transcribed from strongly disagree (1) to strongly agree (5). If a respondent chose ‘prefer not to answer’ then that was transcribed as a blank and not included in the calculated average. Once the average for each question was determined, the average for questions about climate change knowledge, climate change core curriculum and climate change integration were calculated. These averages were displayed in bar charts to allow for comparison between faculties to investigate student perception of climate change learning.

Responses were also transcribed to get the relative frequency of each response from each faculty. The number of responses for strongly disagree to strongly agree were tallied for each faculty. These tallies were taken and turned into percentages to illustrate the relative frequency of each response out of a bar of 100%. These tallies were done for questions about climate change knowledge, climate change curriculum, and climate change integration and displayed in a bar chart out of 100%.

Compiling the responses from the survey to understand students' perception of their climate change learning was done through a quantitative comparison analysis. The comparison analysis of survey responses between and within faculties helped to make distinctions and speculate on the frequency of responses.

I intended to compare the responses within a faculty, between knowledge, curriculum and integration and speculate on any important findings. Through this data, I contrasted my results with outside literature, and I developed an opinion on perception of climate change learning from different faculties at Dalhousie University.

Chapter 4: RESULTS & DISCUSSION

The primary objective of this study was to investigate climate change learning in different faculties at Dalhousie University. This was done by using a Likert scale survey to determine students' perception of their climate change knowledge, climate change core curriculum and climate change integration. The following chapter will identify the results, key findings, and speculate on comparisons between and within faculties. It will also identify the limitations of this study and conclude with further suggestions on climate change learning at Dalhousie University.

The results from the Likert scale survey were collected, transcribed, and compiled into an excel file to be made into bar graphs. The results were organized by questions about climate change knowledge, climate change curriculum and integration of climate change into course content. The scoring was transcribed by attributing numbers to each Likert scale response in the survey; 'Strongly Disagree' is 1, 'Disagree' is 2, 'Neutral' is 3, 'Agree' is 4 and 'Strongly Agree' is 5. The average for each faculty was transcribed (Appendix B, Table 1) and the relative frequency of responses was transcribed and calculated (Appendix B, Table 2).

4.1 Key Findings

The Likert scale survey on climate change learning received low interaction from students. There was a total of 284 responses to the survey. There were a number of incomplete survey submissions and a few submissions from students who identified that they were not in their final year. These submissions were removed from the data, leaving 141 responses that were complete and from students in their final year of study. Although the survey was sent out to all the undergraduate faculties, there were no student responses from the Faculty of Computer Sciences, or the Faculty of Medicine. It is important to note that participation from each faculty was not the same. The College of Sustainability had 8 responses, the Faculty of Agriculture had 2, Architecture and Planning had 3, Arts and Social Sciences had 14, Dentistry had 13, Engineering had 29, Health had 10, Law had 13, Management had 8, and Science had 41.

4.1.1 Average Likert Scale Responses

There were varying differences between faculties for student's perceived climate change learning. Overall, the College of Sustainability and the Faculty of Science had the highest

average scores from the Likert scale survey. The College of Sustainability had consistent scores ranging from agree to strongly agree, while the Faculty of Science had high scores for questions about knowledge and integration but had slightly lower scores for questions about core curriculum (Figure 1). The Faculty of Agriculture had similar high scores for questions about climate change knowledge and integration, but comparatively lower score for questions about climate change curriculum, showing a very similar observation to the responses from the Faculty of Science (Figure 1).

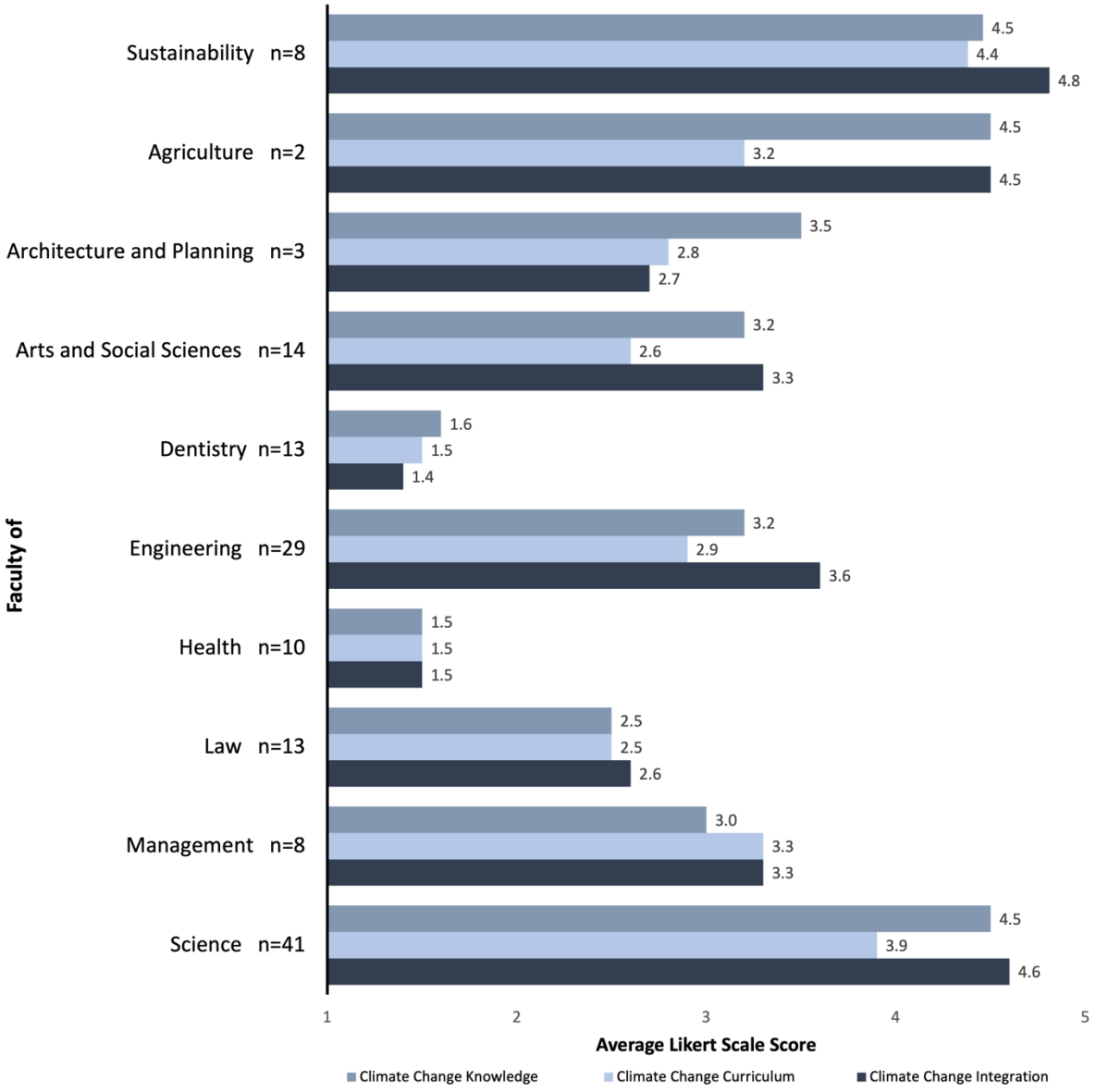

Figure 1 Likert scale survey answers averaged and organized by faculty, including the number of respondents per faculty, for questions about climate change knowledge, climate change curriculum and climate change integration in respective programs at Dalhousie University.

The considerably higher scores from students in the College of Sustainability, Faculty of Sciences and Agriculture was unsurprising considering that these faculties are natural sciences based. HEIs tend to present climate change in disciplinary silos, taught in natural sciences and resource departments (Coleman & Gould, 2019). Climate change adaption in the agricultural sector is a fast-evolving practise with many unknowns, which is why climate change adaption should be an integral part of the Faculty of Agriculture curriculum (Molthan-Hill et al., 2021). This seems to be evident from the results of this survey study as agriculture student gave high average scores for climate change knowledge and integration in their programs (Figure 1). It is interesting that in high scoring faculties, there was a notable decrease in the score for questions about curriculum, as seen with the Faculty of Agriculture and Science (Figure 1). This suggests that students were not taking many courses specifically focused on climate change and that there may not even be many of these courses available. It seems, however, that a potential lack of climate change courses did not impact the ability to integrate climate change into existing courses, as scores for climate change integration are high.

The Faculty of Health and Dentistry had the lowest average scores and there was not much variation between the average scores for climate change knowledge, core curriculum and integration. The Faculty of Health had an average response of 1.5 for every question while the Faculty of Dentistry had similar responses, with an average score of 1.6 for climate change knowledge, 1.5 for climate change core curriculum and 1.4 for integration of climate change (Figure 1). The Faculty of Health and Dentistry were consistently lower than other faculties, an observation that was notable considering the importance of understanding the combined implications of public health and climate change. It is immensely valuable for those working in public health to understand the impacts and responses of climate change that affect human health (Lansbury et al., 2023). The US Department of health and human services established that climate change is one of the top public health challenges of our time (Linstadt, 2023), and yet numerous students who study in this field state that their climate change education is insufficient (Lansbury et al., 2023). Instructors for health care courses also reiterate the importance of understanding climate change to protect vulnerable people from adverse health effects but emphasize their lack of training on the subject (Diallo et al., 2023). If climate change is not integrated into course content, it is difficult for instructors to make those changes in the

curriculum. The health science field is constantly rescoping and improving and climate change learning becomes less of a priority when there are so many more urgent matters at hand (Linstadt, 2023). Previous studies have concluded that health care students see value in the inclusion of climate change in relation to their program and have emphasized that there needs to be more education on climate change and how it impacts the health care world (Lansbury et al., 2023). There is an inclination towards the importance of climate change in health care curriculums, but a barrier in how to make that transition. The lower scores for the Faculty of Health and the Faculty of Dentistry were therefore likely due to uncertainty in how to include climate change knowledge into the existing programs rather than the unimportance of climate change to this field.

The other faculties in Figure 1; Architecture and Planning, Arts and Social Sciences, Engineering, Law, and Management had moderate scores, all of them in the neutral range. This neutral scoring was indicative of there not being enough content on climate change in these programs. Evidently there are limited climate change curriculum requirements, but also a disconnect in the integration of climate change topics into existing course content.

The Faculty of Architecture and Planning had most scores ranging around neutral, with a much higher score of 3.5 for questions about knowledge and comparatively lower scores of 2.8 and 2.7 for questions about curriculum and integration (Figure 1). Architecture and planning have a lot of potential to implement and introduce climate change into their department. This faculty can offer technical solutions to climate change mitigation and adaption through design and planning for urban and rural areas (Padhra & Tolouei, 2023). Although students had a moderate knowledge of climate change, it seems like there were very few, if any, courses about climate change in their program and not extensive integration in course content (Figure 1). The knowledge that these students have on climate change may have come from their department but could also have been attained through courses from other faculties that are not specific to architecture and planning. Although architecture and planning is most definitely impacted by climate change, lower scores in climate change knowledge, curriculum and integration may be due to the difficulty of scoping climate change into the curriculum.

The Faculty of Arts and Sciences also had scores close to neutral. They averaged a score of 3.2 for questions about climate change knowledge, with a much lower score of 2.6 for questions about curriculum and a score of 3.3 for questions about integration (Figure 1). Arts and

social sciences have a major role and influence on the climate crisis, but evidently there seems to be barriers for climate change learning in this faculty. The average Likert scale scoring was right around neutral, but there was a decrease for questions about curriculum (Figure 1). Arts and social sciences have a major role to play in relation to climate change, especially the impacts on society, communities and culture, climate communication and insights into behavioural change (Padhra & Tolouei, 2023). There is an emerging field of climate and environmental humanities focused on the evolution of the language we use to conceptualize climate change (Houghton et al., 2023). There is also a need for understanding complex human societies and discussions about crises management (Houghton et al., 2023). Climate change is political and is a necessary element of the humanities. Education in science and technology tends to be seen as more valuable for the climate crisis when humanities are just as important (Hess & Collins, 2018). The climate crisis requires different perspectives because climate change as a scientific phenomenon is a very different beast to the lived experience of climate change (Houghton et al., 2023).

The Faculty of Engineering had slightly varying scores, all ranging around neutral. The Faculty of Engineering had a score of 3.2 for questions about climate change knowledge, a score of 2.9 for core curriculum questions and a score of 3.6 for questions about integration (Figure 1). The Faculty of Engineering showed some fluctuation, though overall had relatively higher scores in comparison to many other faculties. The highest score was for integration, indicating that, although the scores were not incredibly high, there is some integration in course content. Climate change knowledge had a lower score, and climate change curriculum had the lowest score, indicating that there are still some gaps in presenting climate change information and that there are not many available options for climate change specific courses. Engineers have a considerable effect on world development and have historically been a part of the environmental problems (Taleb et al., 2021). Engineers can provide technical solutions to climate change mitigation and adaption and have a big impact on how countries prepare for climate change and abate greenhouse gas emissions (Padhra & Tolouei, 2023). Considering how essential engineers are to climate change mitigation and adaption, it is unusual that the average scores for the Faculty of Engineering are neutral when they should be as high as other STEM Faculties. Recent curriculum analysis on engineering in HEIs, a case study done in the UK, showed that learning objectives and descriptions in curriculum courses were lacking reference to climate change, mitigation, and adaption (Axelithioti et al., 2023). There seems to be a dissociation between

engineers and climate change which makes it more vital that engineering education accurately portrays the impact the profession can have on climate change (Axelithioti et al., 2023). Even more profound is that Axelithioti et al (2023) found that many engineering students do not consider climate change to be relevant to their careers and education. The Faculty of Engineering results from this survey study are congruent with outside literature and it is evident that there is a disconnect in how climate change is presented in courses.

The Faculty of Law showed very consistent responses, with average responses of 2.5 for climate change knowledge and curriculum and 2.6 for climate change integration (Figure 1). The Faculty of Law had surprisingly low scores, ranking the third lowest of the other faculties that participated in this study. The average responses were consistently ranging from neutral and disagree. This indicates that there was very little climate change knowledge being shared and integrated and that there are few, if any, climate change specific courses. There are numerous ways for law students to engage with climate change, through climate law, policies, and legislation (Padhra & Tolouei, 2023), which is why it is interesting that the Faculty of Law had a lower average. Ireland-Piper & James (2021) argues that law schools have an obligation to ensure that law students are educated in climate law. Climate change law is an intersection between numerous other legal disciplines and is a constantly expanding topic (Ireland-Piper & James, 2021). Teaching climate change law requires a generalist perspective to encompass the scale of the issue (Ireland-Piper & James, 2021). Already, there are numerous law schools that are changing their curriculum, programs, and elective offerings to include more subjects of climate change. It is certain that the climate crisis needs lawyers who understand the legal system and know how to appropriately respond to climate change within their scope (Ireland-Piper & James, 2021). It is essential that climate change is integrated into and included within programs and course curriculums. Lower average responses from the Faculty of Law demonstrated that students perceive they are not learning enough about climate change and how it relates to their studies, indicating that there is a gap in climate change learning for students at Dalhousie Law.

The Faculty of Management also had surprisingly low scores, with scores of 3.3 across all topics, with a slightly lower average of 3.0 for questions about climate change knowledge (Figure 1). It is notable that climate change knowledge had a lower score than that of climate change curriculum and climate change integration. There are a number of ways that Management can be attributed to climate change, through climate finance, investments, and insurance (Padhra

& Tolouei, 2023). Sometimes the world of business can seem very distant from the world of science, especially when climate change tends to be depicted as a science issue. The majority of programs at HEIs tend to scarcely include references to climate change and how their discipline could mitigate climate change (Molthan-Hill et al., 2021). This doesn't mean this program is not influential on the climate crisis, but rather that it might be difficult to conceive how to bridge the gap to include climate change topics in existing content. There is a perceived irrelevance of climate change in multiple subject areas, which makes it all the more difficult to integrate (Cebrian et al., 2015). In comparison to other faculties, management was lower than anticipated, especially considering all the potential to integrate climate change into this subject.

Educators have an obligation to equip students to understand climate change, but also to use their skills to contribute towards building a better future (Houghton et al., 2023). Having this base knowledge creates a pre-disposition in students to react to environmental issues with an understanding and knowledge of how their field relates to and impacts climate change issues (Taleb et al., 2021). All professors are engaged with students that suffer from living in ongoing climate distress (Houghton et al., 2023), so climate change should be a factor in all programs and faculty teachings.

4.1.2 Relative Frequency of Responses

The relative frequency of responses varied throughout faculties (Table 2). It was notable that faculties relating to sciences, such as sustainability, agriculture and science had high frequency responses of strongly agree, with almost no responses being less than neutral (Figure 2). On the flip side, the Faculty of Health and Dentistry had high frequency responses of strongly disagree (Figure 2). The other five faculties; Architecture and Planning, Arts and Social Sciences, Engineering, Law, and Management had a pretty proportionate spread of answers, with the higher percentages of answers being neutral and disagree (Figure 2).

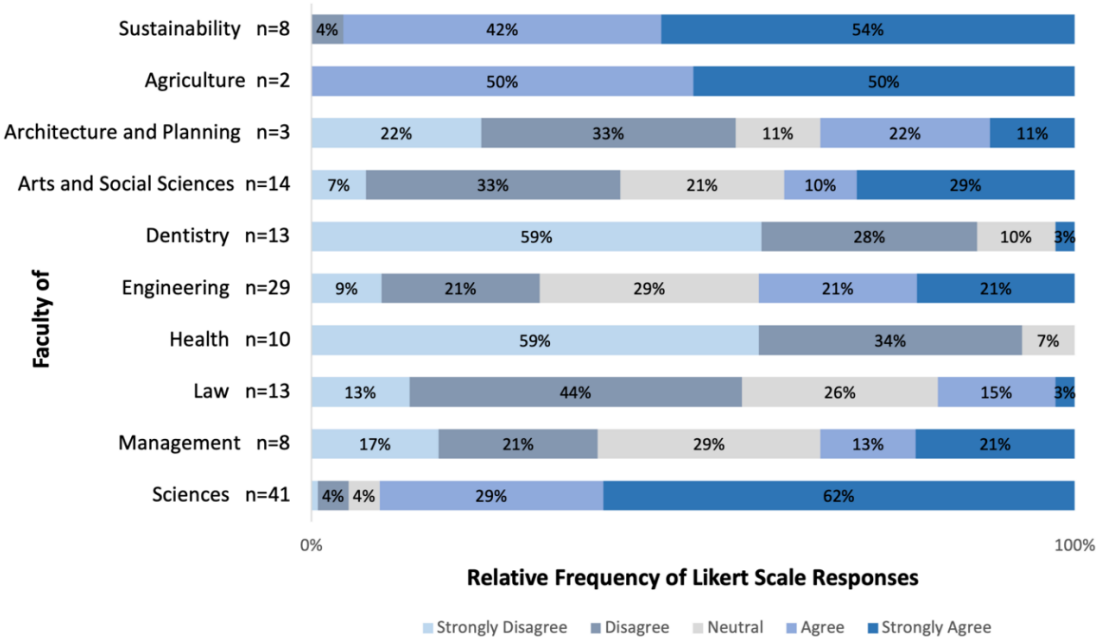

Figure 2 Relative frequency of Likert scale responses for each faculty from survey questions about climate change knowledge.

The relative frequency for questions about climate change curriculum was more dispersed for each faculty in comparison to the results in Figure 2 and 4. Similar to Figure 2, there is a distinctly high frequency of responses for strongly agree for the Faculty of Science and College of Sustainability (Figure 3). There was a distinctly high frequency of responses for strongly disagree for the Faculty of Health and Dentistry (Figure 3). The remaining faculties had a more even frequency distribution, but there was a notably higher percentage of responses for disagree throughout every faculty, with a considerably high response frequency of disagree for the Faculty of Law (Figure 3).

The questions about climate change integration showed similar results to the questions about climate change knowledge. The College of Sustainability, Faculty of Agriculture and Faculty of Science showed high frequency responses for strongly agree (Figure 4). The Faculty of Health and Dentistry showed high frequency responses for strongly disagree (Figure 4). The other faculties showed an even spread of responses, though the Faculty of Law has a high percentage of disagree responses and the Faculty of Engineering has a high response frequency for agree (Figure 4).

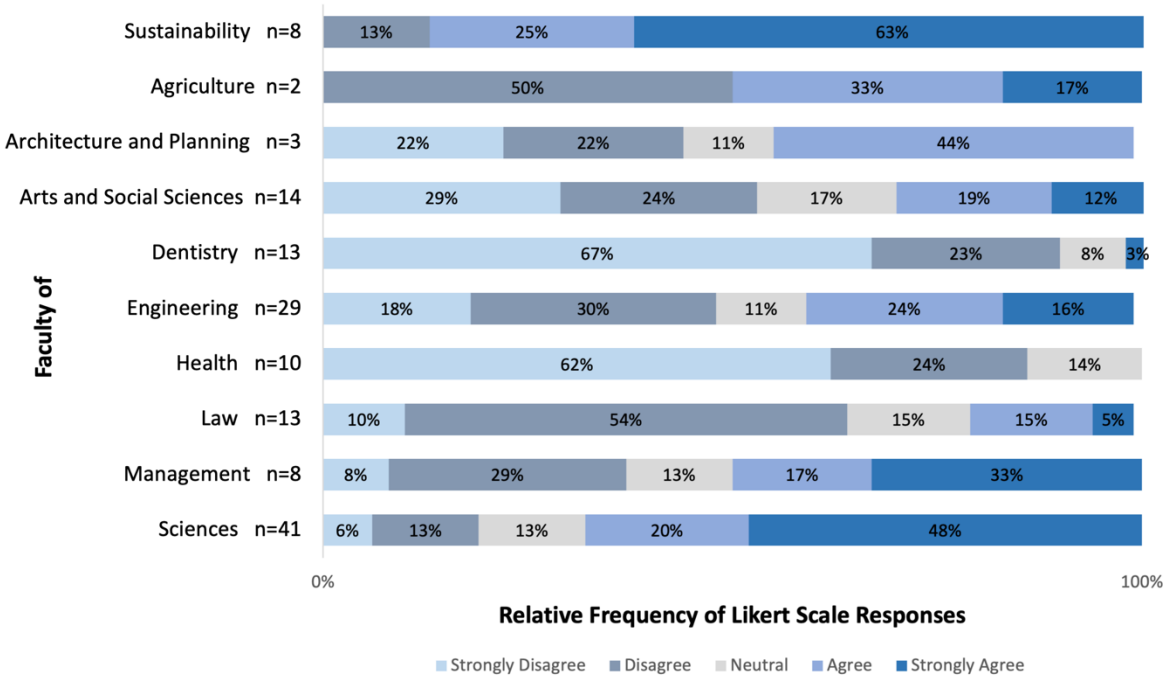

Figure 3 Relative frequency of Likert scale responses for each faculty from survey questions about climate change curriculum.

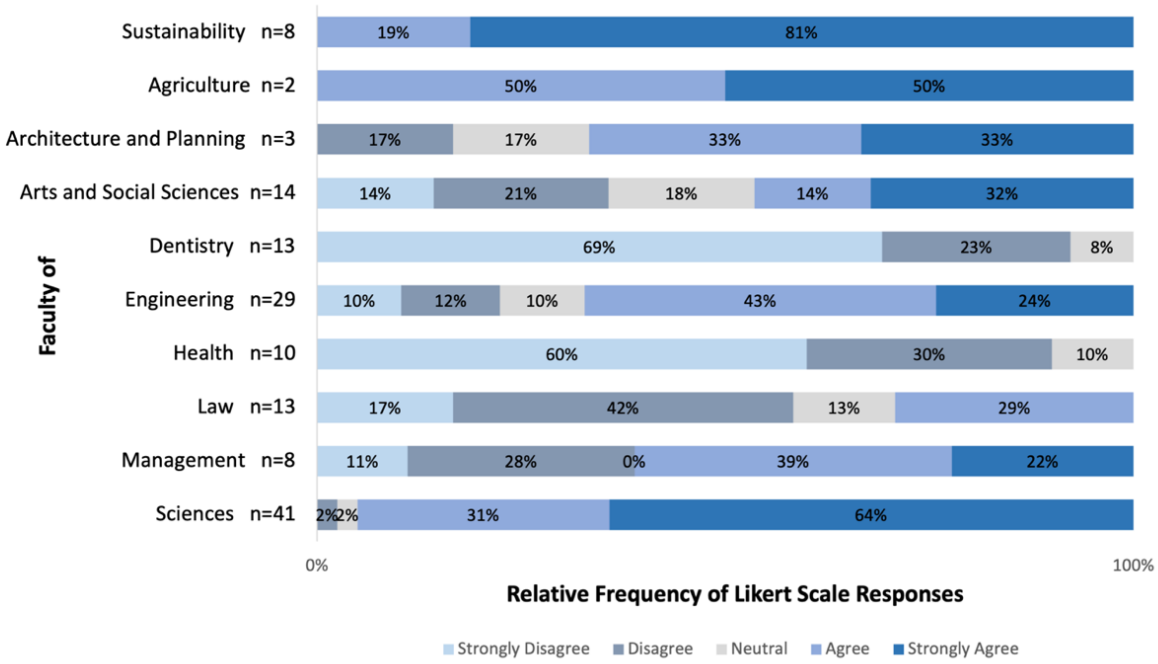

Figure 4 Relative frequency of Likert scale responses for each faculty from survey questions about climate change integration.

The relative frequency of responses was consistent for each faculty across all questions. There was a high frequency response of strongly agree and agree from the College of Sustainability, Faculty of Agriculture and Faculty of Science, which is why these faculties had considerably high average scores for questions about climate change knowledge, core curriculum and integration. The frequency of strongly agree is quite high for sustainability and sciences through all questions, indicative that students believe they are learning enough about climate change, that climate change is mentioned frequently in the required courses of their programs and there is sufficient integration of climate change topics into already existing curriculum. The Faculty of Agriculture had similar findings of sufficiency and agreement for climate change knowledge and integration. There is a shift in responses for the Faculty of Agriculture for questions about climate change core curriculum, where disagree responses are in the majority. This shift indicates that maybe there is not enough core curriculum that focused on climate change in this faculty. Climate change core curriculum is an important aspect of any faculty because these types of courses increase student knowledge but can also overcome student's selective exposure bias and resistance to climate change related courses (Hess & Maki, 2019).

On the flip side, there was high frequency responses for strongly disagree and disagree from the Faculty of Health and Dentistry. This was consistent for both faculties across all questions. This indicated that climate change learning in the Faculty of Dentistry and Faculty of Health is minimal. This is in keeping with the literature on the subject, showing that students in health tend to consider that they had not previously received sufficient education or learning experiences on the topic of climate change (Lansbury et al., 2023). There are major benefits to exposing students to climate change topics during their studies to increase awareness and knowledge (Lindstadt, 2023), so that they might build towards behavioural change in their profession.

The rest of the faculties have roughly equal spreads of frequency of responses. Many faculties such as the Faculty of Architecture and Planning, Arts and Social Sciences, Engineering, Law, and Management are divided in this way, indicating that likely climate change learning is quite different depending on department, discipline, and a student's own academic path within these faculties. This array could be attributed to differences in perception and how this information was presented to them. It could also be attributed to inconsistent climate change

learning through the years, but it is likely because there are multiple different programs within a faculty that likely have very different climate change learning opportunities.

4.1.3 Differences in Average Scores Between Questions

Lower scores for questions about climate change knowledge was indicative that students don't believe they are learning enough about climate change in their program. The questions in the Likert scale survey used terms like 'enough' and 'considerable', terms left purposely ambiguous to determine how students felt about their climate change learning. There was an overall observation for all faculties, that are not based in physical sciences, that the students are not learning enough about climate change, that the core curriculum in their program does not include enough topics on climate change and that climate change is not mentioned frequently in the required courses of the program.

There was a considerable observation for many faculties that the average Likert scale scoring for questions about climate change curriculum were much lower than the scoring for questions about climate change knowledge and integration. In comparison to other questions, there were more disagree and neutral responses for questions about climate change core curriculum, with frequency of responses shifting more towards the disagree end of the chart (Figure 3). This observation was seen throughout the results and illustrates that there are less climate change specific courses offered or available for faculties. Although sustainability and sciences still had most responses for strongly agree, all other faculties seem to be lacking in core curriculums.

The inclusion of climate change specific courses can be a challenge to implement at HEIs. There was an observation in recent literature that climate change courses tend to be offered with more frequency to science disciplines than any other discipline (Hess & Collins, 2018). Core curriculum lists of courses for certain programs can be strongly set and not flexible for changes or additions (Hess & Collins, 2018). Major changes to core curriculum tend to be directed by administrations and not faculty members, which means that there are several barriers if certain departments wanted to include climate change specific courses (Hess & Collins, 2018). Another element to the lower scores for climate change curriculum is that when there are climate change specific courses, they tend to be offered but not required for different degrees (Hess & Collins, 2018). This leads to certain confirmation bias, as students who would rather not learn

about climate change can simply choose to avoid those courses (Hess & Collins, 2018, Hess & Maki, 2019).

Interdisciplinary curriculum contributions are needed to increase climate change learning in all faculties, as well as increases in staff training on the subject (Leal et al., 2021, Stubbs, 2018, Molthan-Hill et al., 2021). In past years it seems that HEIs have failed to update their general curriculum to include topics of climate change and ensure all students are exposed to climate change education (Hess & Collins, 2018). The embedment of climate change courses can be successfully done in any discipline, as was proven by Padhra & Tolouei (2023). There needs to be action and time given to transitioning climate change topics into core curriculum so as to push beyond conventional curriculum standards (Houghton et al., 2023)

There are numerous examples of HEIs that have integrated climate change courses into their establishment, sometimes even making it mandatory for students to take these courses. The KTH royal institution of technology made a goal to include climate change in curricula on all levels of educational programing (Leal et al., 2021). The University of Vermont has developed new sustainability requirements for undergraduate students and strives to include topics regardless of discipline (Coleman & Gould, 2019). Stubbs et al (2018) wrote about a climate change interdisciplinary course requirement for undergraduate students that consisted of a core nine credit hours that cross disciplines and is distinctly humanities, natural sciences, and social sciences. There are many more examples, but the point is that climate change requires contributions from all academic disciplines, so courses about climate change should be taught with a multi-disciplinary or transdisciplinary lens (Padhra & Tolouei, 2023).

Sometimes the easiest and best approach to getting climate change knowledge into course content is to simply integrate it into existing courses (Padhra & Tolouei, 2023, Leal et al., 2023). This is reflective in Figure 1 where the highest scores were for questions on climate change integration. The majority of scores for climate change integration questions were equally as high as climate knowledge questions or even higher (Figure 1). This was evident in the scores for all faculties except for the Faculty of Architecture and Planning and the Faculty of Dentistry. This observation in higher climate change integration scores was insightful. Previous survey studies sent out to staff and professors at different universities have shown that staff were responding neutrally to questions about if the university had embedded climate change into teachings and learnings (Leal et al., 2021). This observation then exceeded previous studies expectations,

showing that although there was low scoring for core curriculum, the integration into course content is one of the better fields. Evidently integrating climate change content into existing departments and courses poses a challenge, but it has been proven through the literature that it can be done – and can be integrated into a range of faculties (Coleman & Gould, 2019, Padhra & Tolouei, 2023). The contextualization of climate change leanings in existing courses enables students to better understand the issues from the perspective of their field (Padhra & Tolouei, 2023). The complexities of climate change require a multidisciplinary approach, which also means there are a number of options for how to integrate this content into existing programs. That being said, there was still major fluctuation between faculties when it comes to the scoring of climate change integration. The average scores for the College of Sustainability, the Faculty of Agriculture and Faculty of Science are still the highest. To reiterate; it may be easier for faculties in natural sciences to embed climate change learning into their curriculum and may be harder for other faculties to conceptualize the integration.

4.2 Limitations and Further Research Potential

There were a number of limitations associated with this survey study. The first being the unknown number of students in their final year of each faculty. There were no numbers publicly associated with the students in their final years, so there was no way to determine how many responses would be necessary to have a robust depiction of the population for each faculty. There were very few responses from students in agriculture and architecture and planning. These responses were included in the results but there is some uncertainty as to how accurate a depiction those responses were to the full student body that was in their final year.

This survey study was implemented to investigate students' perception on their climate change learning, so all the results are student impressions of what they think they are learning. I would argue that perception of what a student is learning is more important than what the student is learning because their perception is representative of what information got through. Further information on people's perception of their climate change education could be acquired through interviews as this would likely present a more comprehensive overview of students' perceptions on their climate change learning.

Although questions were tailored to students' perceived learnings about climate change in their faculty, it is entirely possible and expected that students have gained knowledge of how

climate change relates to their field from outside their faculty. It may be difficult for some students to separate the origin of their learnings. The questions posed in the survey are solely focused on what students perceive they have learned through their program to try to mitigate this risk.

An objective in this study was to determine if students perceive that climate change topics are included in their programs core curricula, and therefore there are a number of questions about the integration of climate change in that curriculum. The difficulty when analysing climate change education integration in course content is that sometimes climate change topics have been integrated in different ways that aren't always obvious to the outside observer. Sometimes climate change topics have been solely designated to a course by itself, either required or not (Hess & Collins, 2018). It is difficult to determine how climate change is presented in students' curricula solely by asking their perception on the integration of climate change. To further investigate climate change learning at Dalhousie University, it would be imperative to do a curriculum analysis to further our understanding of how climate change has been integrated, or not, into respective faculties.

4.3 Recommendations and Conclusion

Going forward there are several steps to consider. The Faculty of Science, Agriculture and College of Sustainability seem to have the highest climate change learning scores, with students perceiving they have enough interaction with climate change topics. All other faculties could do with further inclusion of climate change learning, especially the Faculty of Dentistry and Health.

Having climate change core curriculum is not a necessity to have climate change integration in existing courses, as scores for climate change integration were higher than core curriculum and knowledge. Although not a necessity for integration, climate change core curriculum is still useful and still scored quite low across all faculties. This would insinuate that it is more important than ever to include climate change core curriculum requirements in all faculties to increase knowledge and to avoid biases. These courses should be multi-disciplinary by nature and should convey the integration of climate change into numerous faculties and subjects.

There is a perceived inability and uncertainty in how to include climate change learning in existing curriculum, which poses a challenge. To further the inclusion and integration of climate change topics into existing programs and structures there needs to be institutional change. Integration of climate change topics into any program or faculty is possible and necessary, much of the recent literature on climate change education proves this. The tools are available for this to occur, which means that there needs to be a change on the institutional level. There are evidently gaps in the climate change learning at Dalhousie specific to faculty. Educators have an obligation to equip students to understand climate change and to use their skills to contribute to building a better future, which is why these gaps in Dalhousie University's learning must be appropriately addressed.

APPENDIX A

Research Instrument: Survey Questions

Research Question: Are students learning about climate change in their respective departments of faculty at Dalhousie University?

Section 1:

Confirm you are in your final year of your undergraduate degree at Dalhousie University:

Yes

No

Identify your Department of Faculty:

College of Sustainability

Faculty of Agriculture

Faculty of Architecture & Planning

Faculty of Arts & Social Sciences

Faculty of Computer Sciences

Faculty of Dentistry

Faculty of Engineering

Faculty of Health

Faculty of Law

Faculty of Management

Faculty of Medicine

Faculty of Science

Section 2:

Answer the following statements within the Likert Scale

1. Strongly Disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly Agree
6. Prefer not to answer.

1. I am learning enough about climate change in my program.
2. My program has helped me to understand climate change impacts.
3. I have gained considerable knowledge about climate change through my program.
4. The core curriculum for my program includes enough topics on climate change.
5. Climate change is mentioned frequently in the required courses of my program.
6. There is a climate change focused course in the core curriculum of my program.
7. My program contextualizes climate change topics in course content.
8. I understand how climate change can relate to my studies because of what I have learned in my program.

APPENDIX B

Table 1 Average Likert scale responses for each faculty and for each question in the survey. N indicates the number of responses for faculties and bolded number indicate the average response for questions.

Faculty	N	Climate Change Knowledge			Climate Change Curriculum			Climate Change Integration	
		Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
College of Sustainability	8	4.3	4.8	4.4	4.3	4.8	4.1	4.8	4.9
			4.5			**4.4**		**4.8**	
Faculty of Agriculture	2	4.4	4.8	4.4	4.3	4.8	4.1	4.8	4.9
			4.5			**4.4**		**4.9**	
Faculty of Architecture and Planning	3	2.3	2.7	3.0	2.3	3.3	2.7	3.7	3.3
			2.7			**2.8**		**3.5**	
Faculty of Arts and Social Sciences	14	3.2	3.4	3	2.8	2.7	2.4	3.3	3.3
			3.2			**2.6**		**3.3**	
Faculty of Dentistry	13	1.7	1.5	1.5	1.7	1.4	1.4	1.4	1.4
			1.6			**1.5**		**1.4**	
Faculty of Engineering	29	3.4	3.4	2.8	2.9	3.0	2.7	3.3	3.9
			3.2			**2.9**		**3.6**	
Faculty of Health	10	1.5	1.7	1.3	2	1.3	1.3	1.4	1.6
			1.5			**1.5**		**1.5**	
Faculty of Law	13	3	2.5	2	2.7	2.1	2.7	2.4	2.7
			2.5			**2.5**		**2.6**	
Faculty of Management	8	3.1	3.1	2.8	3.0	3.9	3.1	3.1	3.4
			3			**3.3**		**3.3**	
Faculty of Science	41	4.4	4.5	4.5	4.0	4.3	3.6	4.5	4.7
			4.5			**3.9**		**4.6**	

Table 2 The number of responses for each Likert Scale option, for each faculty, categorized by questions, used to later calculate the relative frequency for each question.

Questions about Climate Change Knowledge										
	Sustainability	Agriculture	Architecture and Planning	Arts and Social Sciences	Dentistry	Engineering	Health	Law	Management	Sciences
Strongly Disagree	0	0	2	3	23	8	17	5	4	1
Disagree	1	0	3	14	11	18	10	17	5	5
Neutral	0	0	1	9	4	25	2	10	7	5
Agree	10	3	2	4	0	18	0	6	3	36
Strongly Agree	13	3	1	12	1	18	0	1	5	76
Prefer not to answ	0	0	0	0	0	0	1	0	0	0
Sum	24	6	9	42	39	87	30	39	24	123
Questions about Climate Change Curriculumn										
Strongly Disagree	0	0	2	12	26	16	18	4	2	7
Disagree	3	3	2	10	9	26	7	21	7	16
Neurtal	0	0	1	7	3	10	4	6	3	16
Agree	6	2	4	8	0	21	0	6	4	24
Strongly Agree	15	1	0	5	1	14	0	2	8	59
Prefer not to answ	0	0	0	0	0	0	1	0	0	1
	24	6	9	42	39	87	30	39	24	123
Questions about Climate Change Integration										
Strongly Disagree	0	0	0	4	18	6	12	4	2	0
Disagree	0	0	1	6	6	7	6	10	5	2
Neurtal	0	0	1	5	2	6	2	3	0	2
Agree	3	2	2	4	0	25	0	7	7	25
Strongly Agree	13	2	2	9	0	14	0	0	4	52
Prefer not to answ	0	0	0	0	0	0	0	2	0	1
	16	4	6	28	26	58	20	26	18	82

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