UBC Social Ecological Economic Development Studies (SEEDS) Sustainability Program

Student Research Report

Confidence in Literacy: Understanding Students' Willingness to Take Climate Action

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University of British Columbia

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Clim-lit Seedlings: Aaron Petrasch, Matyas Barta, Samuel Troya, Stuart Clarke, Vajra Keller

EXECUTIVE SUMMARY: In March 2020 at the University of British Columbia, we tested a broad group of fellow students' climate literacy and learned helplessness levels with one survey presented in two classes and another released online. We asked: Do learned helplessness and climate literacy scores predict students' willingness to engage in climate action? Our group aimed to correlate commonly-used indicators of learned helplessness and performance on a novel climate literacy quiz with willingness to act sustainably. To isolate the relationship between climate literacy levels and actions, every participant first took a 6 question quiz on climate literacy, and then answered 3 questions on sustainability actions they would be willing to incorporate into their lives. Besides the correlations, the corresponding data sets generally estimate undergraduate students' knowledge of actions that can help mitigate climate change and their willingness to engage with them. Unexpectedly, our strongest correlations resulted from the inclusion of a confidence measure before participants were quizzed on climate literacy. We found significant correlations for literacy predicting confidence and confidence with willingness to act. Hence, our group suggests that UBC focus on encouraging confidence in climate education to promote its vision of educating more climate-conscious and upstanding global citizens.

INTRODUCTION: Climate literacy is defined as the "ability to make informed and responsible decisions with regard to actions that may affect climate" (NOAA, 2020). A climate literate individual possesses the knowledge to take necessary steps towards taking care of our climate system. Benefits of climate literate populace are reducing the impact of climate change on ecosystems and communities most affected (NOAA, 2020). The relationship between climate literacy and pro-environmental behaviors has been previously researched, with one study examining how a combination of meditation training and climate literacy focused education can influence climate-positive behaviors in their participants (Grabow et al., 2018). They were able to demonstrate that the implementation of their program was highly feasible and provided us a reasonable foundation for testing climate literacy knowledge in students at UBC.

While climate literacy enables people to make informed decisions in regard to climate action, *learned helplessness* may be a barrier that limits climate literate individuals from participating in climate action. Learned helplessness is defined by American psychologist Martin Seligman as "a mental state in which an organism forced to bear aversive stimuli, or stimuli that are painful or otherwise unpleasant, becomes unable or unwilling to avoid subsequent encounters with those stimuli, even if they are 'escapable' presumably because it has learned that it cannot control the situation" Rosseel (2012). An individual demonstrating a high degree of learned helplessness may not engage in environmentally helpful behaviors, as they feel that their efforts will not have any impact on the whole weight of the situation. Studying learned helplessness within environmental psychology provides an opportunity to reveal indicators of an individual's engagement in pro-climate behaviors.

Previous research has focused on examining the relationship between learned helplessness and pro-environmental behaviors using a Learned Helplessness Scale (Landry et al., 2018). The study found that learned helplessness moderated pro-environmental behaviors (Berman, Jonides,

& Kaplan, 2008). We proposed to study this relationship in students from all year levels attending UBC. Do learned helplessness and climate literacy scores predict students' willingness to engage in climate action? We hypothesized that UBC students will demonstrate three relationships: (i) Students who score higher in climate literacy are more willing to engage in climate action; (ii) Learned helplessness is negatively correlated with students' willingness to engage in climate action; and (iii) Helplessness moderates the effect between climate literacy and willingness to engage in climate action. We expect students with higher levels of climate literacy to display more willingness to engage in climate action. Also, we expect students higher in helplessness to display less willingness to engage in climate action. Further, we expect helplessness to moderate the effect of climate literacy on willingness to engage in climate action, inasmuch as higher values dampen the effect.

Participants: We aimed to recruit students from all faculties and lectures ranging from first year 100-level courses to fourth year 400-level courses at the University of British Columbia, Vancouver. A power analysis was conducted on a comparable study (Landry et al., 2018) to determine the minimum sample size necessary for our study to show significant results. Our power analysis showed a sample size of N = 51 was required for one predictor, an alpha-error level of .05, power of .95 and an R^2 of .21.

We received 107 Kahoot! responses from one section of PSYC 101 and 43 Kahoot responses from one section of MATH 200. After moving our quiz online and presenting it as a Google Form we received 78 responses. In total we collected 228 responses.

Exclusion criteria: We were only interested in UBC students for this study, so we removed responses from participants who did not attend UBC. In order to do a fair analysis, we also removed participants who did not answer all of the questions of the quiz. After the exclusion, we had 92 responses from PSYC 101, 35 responses from MATH 200, and 62 responses from the Google Forms. In total 189 responses were kept for further analysis. No demographic information was collected.

Conditions: Since our study was a correlational design rather than a non experimental design there were no conditions to report on. The independent variables were Climate Literacy scores and Learned Helplessness scores. The dependent variable was the Willingness to Engage in Climate Action score. A Climate Literacy score was determined by the number of correct responses to climate related questions, with 1 assigned to responses to the correct answer and 0 to all others. A Learned Helplessness score was measured by translating qualitative responses from our Learned Helplessness survey quantitatively onto a four-point scale. A higher score indicated a stronger tendency of Learned Helplessness. Willingness to Engage in Climate Action score was measured similarly to the Learned Helplessness score. Using this data, we conducted a multiple linear regression analysis to assess the relationship between climate literacy, willingness to engage and learned helplessness.

Measurements: Kahoot! was our platform of choice for presenting our survey to students at UBC (Kahoot!, 2020). Kahoot! is a freely available online platform which allows users to create multiple choice quizzes. It presents the questions in a game-like setting where participants receive points for correct answers (see Appendix B for screenshots). We selected Kahoot! over self-administered handouts because it communicated a single questionnaire in an engaging manner to many students

at the same time. Following the shutdown of the UBC campus to limit the spread of COVID-19, we moved our survey online via Google Forms and collected responses from any willing participants.

The quiz was designed to measure three unique factors: (i) Climate literacy; (ii) Willingness to engage in climate action; and (iii) the extent to which individuals engage with learned helplessness. We also included another confounding factor for investigation: (iv) confidence in knowledge about climate action. Overall, the quiz consisted of 11 questions which set out to measure these four factors: 5 on climate literacy, 3 on willingness to engage in climate action, 2 on learned helplessness and 1 on confidence about climate knowledge. We recorded responses on a four-point scale because Kahoot! limits multiple choice questions to only four possible options. The climate literacy questions were taken from (Grabow et al., 2018) with some modifications and alterations. Questions on willingness to engage in climate action were taken from a survey in Grabow et al. (2018) which assess one's willingness to engage in climate-conscious behavior. Finally, questions about learned helplessness were taken from the Learned Helplessness Scale (LHS; Quinless & McDermott-Nelson, 1988) which was a survey discussed in Landry *et al*'s paper: a 20-item measure that uses a 4-point Likert-type scale. The list of questions used in our survey for this study can be found Appendix C (Survey Questions).

Procedure: We contacted 39 professors of different UBC courses via email and presented our Kahoot! quizzes to students at the beginning of the lectures of professors who agreed to conduct this study. Four professors agreed to conduct the study. Of the four scheduled lectures, we only collected data from two classrooms, PSYC 101 and MATH 200. Students were asked to participate in a short Kahoot! quiz in the first five minutes of their lecture.

RESULTS: To examine whether climate literacy and helplessness predict willingness to engage in climate action (Hypothesis (i) & (ii)), we ran a multiple linear regression analysis (Hayes, 2017). Literacy did not predict willingness significantly ($\beta = .12$, $SE = .07$, $t(186) = 1.58$, $p = .12$). Helplessness did not predict willingness significantly either ($\beta = .04$, $SE = .07$, $t(186) = -.52$, $p = .60$).

To test the moderation effect of helplessness on the relation between literacy and willingness (Hypothesis (iii)), we conducted a moderation analysis with the lavaan-package in R (Rosseel, 2012). Due to the non-significant predictions in Hypothesis (i) and (ii), an interaction effect of the two variables was not to be expected. However, for the sake of accountability we tested for the effect. The analysis showed a non-significant interaction effect ($\beta = -.08$, $SE = .07$, $t(185) = -1.20$, $p = .23$).

Exploratory analysis: All following statistical analyses were exploratory and post-hoc. Confidence in climate knowledge was an additional one-item variable that was not considered in our hypotheses. However, we included it to see possible associations with literacy, helplessness and willingness. We first did a Pearson correlation between these variables and found significant correlations of confidence with literacy ($r = .22$, $p < .01$) and willingness ($r = .12$, $p < .01$).

These correlations suggest that confidence might mediate the effect of literacy on willingness. After all, the direct effect of literacy on willingness (Hypothesis 1) had not been far from significant either ($p = .12$). We therefore ran a mediation analysis in R (Rosseel, 2012) to calculate this indirect effect. In our model (Figure 1) literacy significantly predicted confidence ($\beta = .22$, $z < 3.08$ $p < .01$) and confidence significantly predicted willingness ($\beta = .22$, $z = 3.03$, $p <$

.01). The indirect effect of literacy on willingness via confidence was significant with β = .05, z = 2.16, p < .03. The direct effect of literacy on willingness was not significant with β = .07, z = 0.98, p < .33.

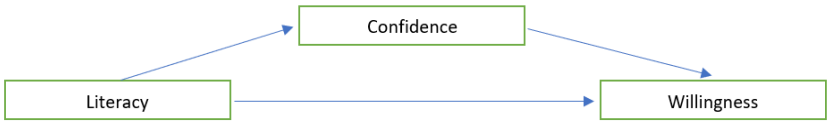

Figure 1. Schematic depiction of the model where confidence mediates the effect of climate literacy on willingness to act.

Because our results were derived from UBC students from different year-levels, we could compare climate literacy between years (Figure 2). We conducted a one-way ANOVA and found a significant difference in their mean literacy (F(3, 185) = 9.89, p < .01. The homogeneity of variances was tested and confirmed with a Levene's test for equality of variances (F3, 185 = .31, p = .82). A post-hoc comparison showed that students in 2nd (t148 = -2.93, pscheffe = .03), 3rd (t110 = -3.18, pscheffe = .02) and 4th year and above (t111 = -4.72, pscheffe < .01) had all higher literacy than 1st year students. Also, 3rd years and above showed higher literacy than 2nd year students (t75 = -4.72, pscheffe < .01). Comparisons between 2nd and 3rd year as well as between 3rd and 4th year students and above were non-significant.

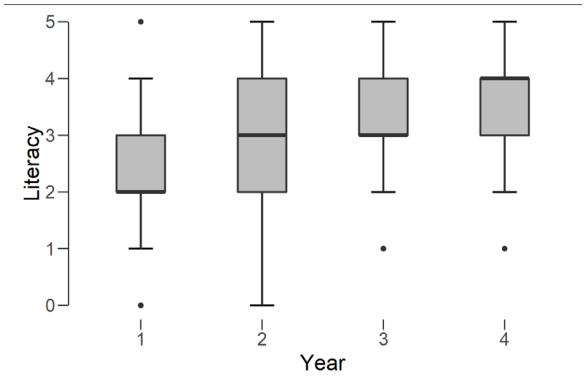

Figure 2. Boxplot displaying the literacy scores divide by year level. 4th year includes students that are higher than in 4th year.

The complete responses for our survey questions and regression analyses can be found in Appendix D (Supplementary Results).

DISCUSSION: Our analyses determined that our hypotheses were not supported in our study. Neither climate literacy nor helplessness predicted willingness to engage in climate action significantly. Our first hypothesis tested that students who score higher in climate literacy are more willing to engage in pro-climate actions. There was a marginal level of correlation between climate literacy and willingness and this relationship was found to be statistically insignificant. Our second hypothesis posited that helplessness is negatively correlated with students' willingness to engage in pro-climate action. Again there was negligible correlation between helplessness and willingness to engage in environmentally conscious actions and this relationship was also found to be statistically insignificant. However, our results show that UBC students' confidence in climate

literacy correlates positively and significantly with climate literacy and willingness to engage in climate action. These results can be translated as UBC students who become more confident in their climate literacy knowledge, through activities such as designing environmental projects and campaigns that enhance student's climate literacy, can be beneficial for engaging students in more pro-climate behaviors.

We encourage replication of our study and further research. Studies should retest the role of learned helplessness and its connection to climate literacy and climate action. We measured helplessness using only two items in our questionnaire. Ideally learned helplessness should be tested by more items, but we designed our questionnaire to be short and time efficient. We predict that using only two items to test this factor contributed to the lack of significant correlations with helplessness. Therefore, further research should be conducted on this topic and our study should be replicated using more items for measuring helplessness. Furthermore we encourage researchers to formulate guidelines for testing climate literacy at UBC. We discuss further challenges in Appendix E (Challenges, Troubleshooting, and Alternative Approaches).

We hope that through further research and replication studies we can demonstrate that confidence can make a difference and that it is key to major changes in sustainable practices. Climate-literate students are more confident in their knowledge about climate change. Confident students are more willing to take affirmative action to mitigate climate change. Furthermore, more future studies should aim to investigate the relationship between helplessness and willingness to engage in climate action. We advise UBC to continue educating students with climate knowledge to encourage their confidence in order to promote a future with people who are willing to act and think about the climate consciously.

RECOMMENDATIONS: In general, results of this project can dictate the direction of future environmental programs regarding action and education at UBC to encourage climate literacy or mitigate climate change helplessness. UBC administrators under the VP Students and faculty-specific staff will have enhanced awareness of how to help students actually engage in climate action. We have provided them information about (a) general, course-specific climate literacy levels of undergraduate students, (b) students' current willingness to engage in climate action, (c) and levels of learned helplessness in regards to the above. Results of this project can dictate the direction of future environmental programs regarding action and education at UBC to encourage climate literacy or mitigate climate change helplessness.

APPENDIX A - References

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Appendix B - Kahoot! and Google Forms Survey Screenshots

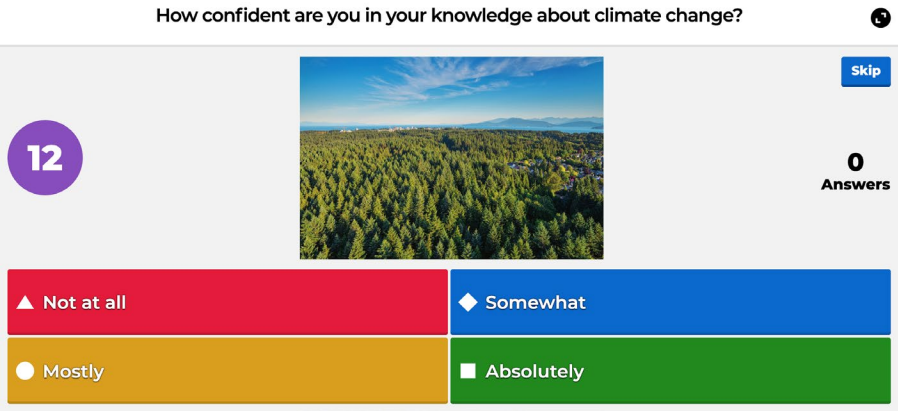


Figure A1. Screenshot of a Kahoot! question presented to students in the classroom. Each question was aided by a relevant image (center) and a countdown timer (left). Students had 60 to answer each question. The responses were recorded on a downloadable spreadsheet. Overall 127 responses were collected on Kahoot!

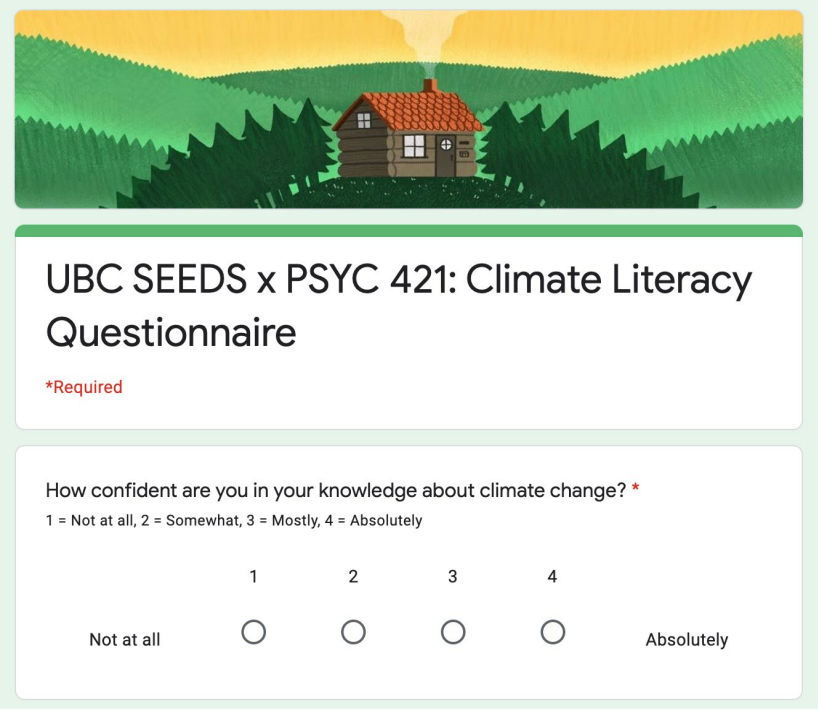


Figure A2. Screenshot of a Google Forms question presented to online participants. All questions were required to be answered to complete the survey. Some questions required quantitative four-point scale answers. The responses were recorded on a downloadable spreadsheet. Overall 62 responses were collected on Google Forms after the UBC campus shutdown.

APPENDIX C - Survey Questions

The questions below were presented to UBC students via Kahoot! and Google Forms. In total we collected 228 responses. 189 responses were kept for further analysis.

Questions to Measure Confidence in Climate literacy (1)

Question 1:
How confident are you in your knowledge about climate change?
Options:

1. Not at all
2. Somewhat confident
3. Mostly confident
4. Extremely confident

Questions to Measure Climate Literacy (5)

Question 2: Which of the following individual actions reduces GHGs most:
Options:

1. Less heating
2. Plant-based diet
3. Live car free
4. Have one fewer child

Question 3: The main cause of eutrophication is…
Options:

1. Runoff of excessive fertilizer and nutrients
2. Oil spills
3. Nuclear energy production
4. Ocean acidification

Question 4: The main cause for ocean acidification is…
Options:

1. Microplastics
2. CO_2 dissolving in seawater
3. Sewage runoff into the sea
4. Overconsumption of O_2 by aquatic organisms

Question 5: Which of the following foods has the greatest carbon footprint per kg?
Options:

1. Cold Cereal
2. Almonds
3. Lamb
4. Blueberries

Question 6: Which industry-wide action can reduce emissions the most (per dollar invested)?
Options:

1. Green roofs
2. Diverting profits to reforestation
3. Phasing out refrigerators and A/C units with hydrofluorocarbons
4. Only using electricity from wind and solar

Questions to Measure Willingness to Engage in Climate Action (3)

Question 7:
How willing would you be to... able to use a clothes line or drying rack instead of a dryer for at least 50% of your laundry?
Options:
1. Very unwilling
2. Mostly unwilling
3. Mostly willing
4. Absolutely willing

Question 8:
How willing would you be to volunteer 5 hours per week for a local environmental organization?
Options:
1. Very unwilling
2. Somewhat unwilling
3. Somewhat willing
4. Absolutely willing

Question 9:
How willing are you to have one less child in order to lessen your impact on climate change?
Options:
1. Very unwilling
2. Somewhat unwilling
3. Somewhat willing
4. Absolutely willing

Questions to Measure Learned Helplessness (2)

Question 10: How much do you agree with the following statement? "No matter how much energy I put into a task, I feel I have no control over the outcome"
Options:
1. Very untrue for me
2. Somewhat untrue for me
3. Somewhat true for me
4. Very true for me

Question 11: How much do you agree with the following statement? "I do not try new tasks if I have failed similar tasks in the past"
Options:
1. Very untrue for me
2. Somewhat untrue for me
3. Somewhat true for me
4. Very true for me

APPENDIX D - Supplementary Results

Model Summary

Model	R	R^2	Adjusted R^2	RMSE
1	0.118	0.014	0.009	2.056

ANOVA

Model		Sum of Squares	df	Mean Square	F	p
1	Regression	10.868	1	10.868	2.572	0.111
	Residual	769.170	182	4.226		
	Total	780.038	183			

Model		Unstandardized	Standard Error	Standardized	t	p
1	(Intercept)	8.040	0.382		21.024	< .001
	S_Literacy	0.211	0.132	0.118	1.604	0.111

Table A1. Linear regression analysis for hypothesis (i): students who score higher in climate literacy are more willing to engage in climate action. Literacy did not predict willingness significantly ($\beta = .12$, $SE = .07$, $t(186) = 1.58$, $p = .12$).

Model Summary

Model	R	R^2	Adjusted R^2	RMSE
1	0.041	0.002	-0.004	2.068

ANOVA

Model		Sum of Squares	df	Mean Square	F	p
1	Regression	1.338	1	1.338	0.313	0.577
	Residual	778.700	182	4.279		
	Total	780.038	183			

Model		Unstandardized	Standard Error	Standardized	t	p
1	(Intercept)	8.856	0.476		18.595	< .001
	S_Helplessness	-0.058	0.103	-0.041	-0.559	0.577

Descriptives

	N	Mean	SD	SE
S_Willingness	184	8.603	2.065	0.152
S_Helplessness	184	4.380	1.485	0.109

Table A2: Linear regression analysis for hypothesis (ii): Helplessness decreases students' willingness to engage in climate action. Helplessness did not predict willingness significantly (β = .04, SE = .07, t(186) = -.52, p = .60).

Model Summary

Model	R	R^2	Adjusted R^2	RMSE
1	0.219	0.048	0.043	1.132

ANOVA

Model		Sum of Squares	df	Mean Square	F	p
1	Regression	12.040	1	12.040	9.396	0.002
	Residual	239.622	187	1.281		
	Total	251.661	188			

Coefficients

Model		Unstandardized	Standard Error	Standardized	t	p
1	(Intercept)	1.791	0.299		5.986	< .001
	Confidence	0.320	0.105	0.219	3.065	0.002

Table A3. Linear regression analysis for hypothesis (iii): People who are more literate feel more confident about their knowledge. Pearson correlation between these variables revealed significant correlations of confidence with literacy (r = .22, p < .01) and willingness (r = .12, p < .01).

Questions to Measure Confidence in Climate literacy (1)

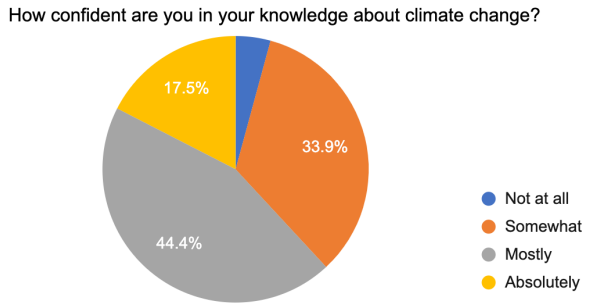
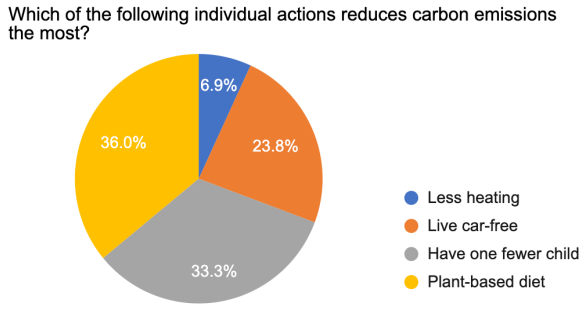
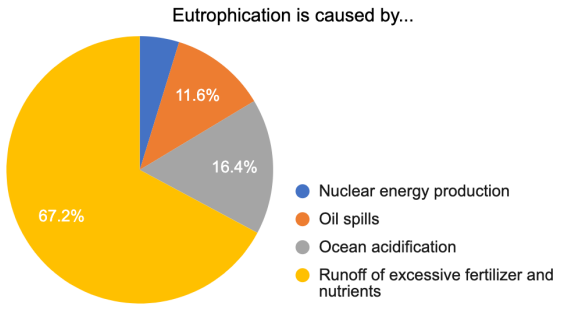
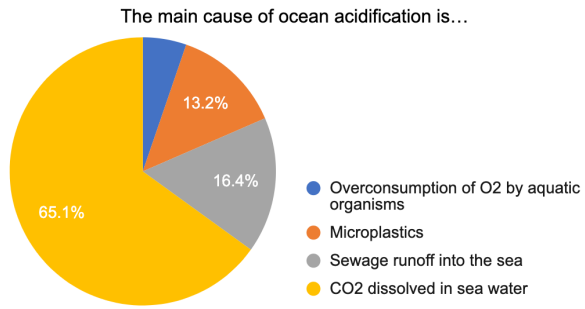


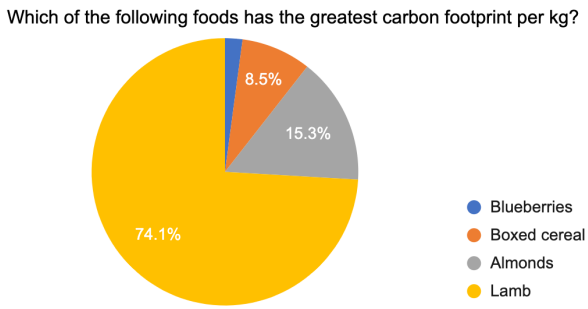
Figure A3. Confidence in climate literacy. 95% of UBC students who responded to this study were at least "Somewhat" confident in their knowledge of climate literacy. 44.4% of UBC students were "Mostly" confident in their knowledge about climate change. The least common response (4.2%) to this question was "Not at all". N = 189.

Questions to Measure Climate Literacy (5)









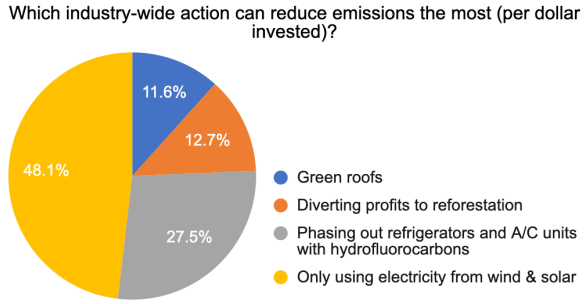


Figure A4. Test on climate literacy. Correct answers from left to right, top to bottom: (i) Have one fewer child; (ii) Runoff of excessive fertilizer and nutrients; (iii) CO_2 dissolved in seawater; (iv) Lamb; (v) Only using electricity from wind and solar. Our participants had the most difficulty with question (i), with only 33.3% correct responses. Question (iv) was the most consistently answered question with 74.1% correct responses. N = 189.

Questions to Measure Willingness to Engage in Climate Action (3)

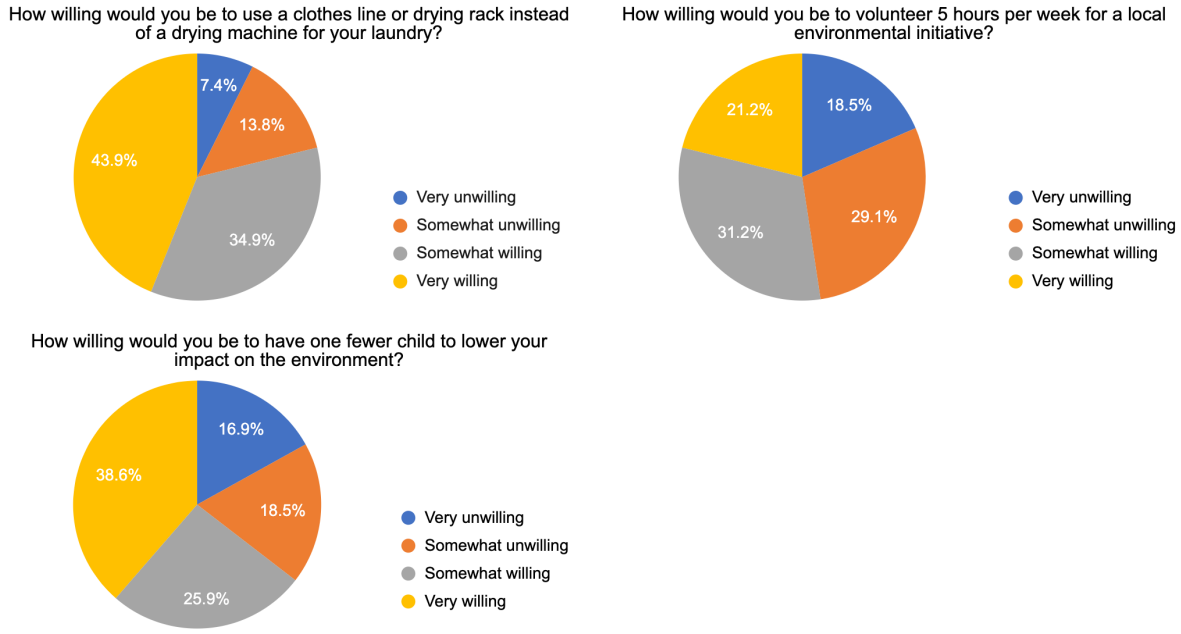


Figure A5. Willingness to engage in climate action. Almost 79% of UBC students in this study are at least "Somewhat willing" to use a clothes line or drying rack instead of a drying machine for drying their laundry. Only 42.4% of UBC students are at least "Somewhat willing" to volunteer 5 hours per week for a local environmental initiative. Almost 72% of UBC students are at least "Somewhat willing" to have one fewer child to lower their impact on the environment. N = 189.

Questions to Measure Learned Helplessness (2)

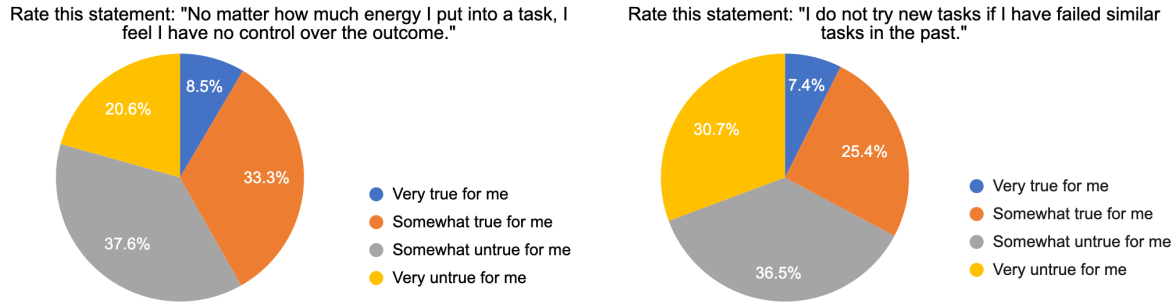


Figure A6. Learned helplessness. 58.2% of UBC students who participated in this survey found the first statement to be at least "Somewhat untrue", while 67.25% of UBC students found the second statement to be at least "Somewhat untrue". The more "true for me" the participants identified with these statements, the higher their Learned Helplessness score. N = 189.

APPENDIX E - Challenges, Troubleshooting and Alternative Approaches

To initiate our research, we wanted to incorporate a formal definition of climate literacy in the design of our study. The National Oceanic and Atmospheric Administration (NOAA), which is associated with the US Department of Commerce, is an agency that uses cutting-edge research and high-tech instrumentation to provide citizens, planners, emergency managers and other decision makers with reliable information about climate science. Information provided on the NOAA website provides guidelines for how climate literacy should be taught by educators around the world. Other studies may define climate literacy differently, but the definition of climate literacy by the NOAA provided us with a good foundational basis to begin our research.

We have found previous studies that explored climate literacy testing using a survey with encouraging results. For the purposes of this study, we adapted questions from Grabow et al., (2018), a study which measured the effectiveness of climate literacy in the context of a pro-climate mindfulness training program. Other questions in our study, such as those which measure willingness to engage in climate action and learned helplessness, were similarly adapted from previous studies (Landry et al., 2018; Grabow et al., 2018). Since our study mainly focused on climate literacy, we set out to ask 5 questions for testing climate literacy, 3 questions for willingness to engage in climate action, and 2 questions for learned helplessness. The questions included in our survey were selected at random from the previously mentioned studies. These questions were further evaluated using participant feedback from a pilot study we conducted online using Google Forms prior to our data collection.

We initially wanted to include more student responses from a wider range of lectures. Out of the 39 emails sent to various professors, we received responses from only 10 of those professors. 4 agreed to conduct the survey in their classroom, but 6 professors declined to participate completely. However, due to unforeseen COVID-19-related circumstances that led to a UBC-wide campus shutdown, we were only able to conduct Kahoot! surveys in two of the planned lectures. Other platforms considered for conducting our surveys online include Google Forms, Qualtrics and Mentimeter. We used Google Forms because we were more familiar with its user interface and we found it was relatively very easy to share the link to our survey through social media. Qualtrics is a strong alternative to Google Forms that is freely available to UBC students and it complies with the BC Freedom of Information and Protection of Privacy Act (FIPPA) because the survey data is kept secure and is stored and backed up in Canada. Finally, after initial testing, we found that Kahoot! was the better option over Mentimeter for in-lecture surveys because it was more complete in the way the data was stored in spreadsheets.