sustainability

MDPI

Article

Living Learning Communities as Climate Change Pedagogy: Understanding the Impact of the Sustainable Living Experience on Climate Change Leadership among First Year Students

Emily Canosa [1,*], Joseph Trumpey [1], Luis M. Espinoza Bardales [2] and Jacqueline Cardoza [3,*]

[1] Sustainable Living Experience, University of Michigan, Ann Arbor, MI 48109, USA
[2] Department of Economics, University of Michigan, Ann Arbor, MI 48109, USA
[3] School of Public Health, University of Michigan, Ann Arbor, MI 48109, USA
* Correspondence: emcanosa@umich.edu (E.C.); jcardoza@umich.edu (J.C.)

Abstract: This study sought to understand the relationship of environmentally-themed Residential Learning Communities (RLCs) with aspects of Climate Change Leadership (CCL) among first-year college students. Two years of survey data were used to assess changes in CCL among students at the University of Michigan, including participants in an RLC known as the Sustainable Living Experience (SLE), neighboring residents, and students in other residence halls. Results showed greater increases in likelihood of reporting positive CCL outcomes for SLE participants, and in many cases also for neighboring students. These effects were often greater for SLE participants who are also underrepresented minority students. Findings indicated that the presence of an environmentally-themed RLC may be related to the development of CCL for neighboring students in addition to program participants. The study also observed campus-wide positive effects on several CCL outcomes after the first year of college, indicating that the campus environment and infrastructure itself can also be leveraged in support of student CCL outcomes.

Keywords: climate change education; leadership; education for sustainability; residential learning communities; first-year students

Citation: Canosa, E.; Trumpey, J.; Espinoza Bardales, L.M.; Cardoza, J. Living Learning Communities as Climate Change Pedagogy: Understanding the Impact of the Sustainable Living Experience on Climate Change Leadership among First Year Students. *Sustainability* **2022**, *14*, 14282. https://doi.org/10.3390/su142114282

Academic Editors: Michaela Zint, Jessica Ostrow Michel and Marc A. Rosen

Received: 20 January 2022
Accepted: 24 October 2022
Published: 1 November 2022

1. Introduction

In the 21st century, colleges and universities across the world have been realizing their potential as actors in solving the challenges presented by global climate change. While the unique capacity of higher education institutions for addressing sustainability has been identified [1–3], researchers have also indicated that previously studied pedagogical approaches at these institutions are often insufficient in teaching about complex issues such as sustainability and climate change [4–7]. If one contribution that universities can offer to address climate change is to cultivate students as leaders in the field, then there is a need for research on how Climate Change Leadership (CCL) can be effectively developed in higher education. This study may be the first to offer insights into the role of Residential Learning Communities (RLCs) as an approach to developing CCL. Using a survey conducted each Fall and Spring for two academic years (2017–2018 & 2018–2019), this study examined a specific environmental RLC, the Sustainable Living Experience (SLE), and correlations with CCL for participants and neighboring students.

2. Literature Review

2.1. Residential Learning Communities and CCL

Effective CCL pedagogies must extend beyond the classroom because CCL requires skills that are applied in the real world. As such, the RLC—a program that blends thematically related curricular and co-curricular components in a residential context—is an applicable model for examination as CCL pedagogy. While the relationship between RLCs

and CCL (or other types of leadership) has not been explored, the relationship with other benefits for students has received noteworthy attention. RLCs have been linked with college persistence [8–11] and successful transition to college [12–14], higher academic outcomes [8,10,15–18], increased levels of engagement [10,16,17,19,20] and other aspects of student wellbeing [21,22]. In many cases these results are particularly pronounced for underrepresented students [9,18,23].

In addition to blending learning inside and outside the classroom, RLCs are an applicable model for further research since studies have suggested their impact may extend beyond participating students [24,25]. RLCs may vary in size from a few dozen to a few hundred students, and students living in the same residence hall as RLCs can number in the hundreds to the thousands. A 1999 study at the University of Michigan (UM) by Inkelas found spillover effects among non-RLC students living in buildings where these communities are located [24]. Neighboring students (in addition to RLC participants) were found to be more likely to discuss socio-cultural issues with peers and report socially supportive residential environments than those living in halls with no RLC. Another study by Longerbeam, Inkelas, & Brower had similar findings, noting that students in RLCs and RLC program buildings are likely to perceive their residential climates as more socially supportive and have more positive diversity interactions with their peers than those in other residence halls [25]. Additional research has indicated that the benefits of RLCs have potential to spread not only beyond immediate participants, but also beyond student academic success into campus priorities such as diversity, equity and inclusion [18,22,24–27]. At the UM, where this study was conducted, another campus priority is defining a path to carbon neutrality [28]. Fostering a culture that supports these goals has been an important focus of UM efforts to address climate change, and the development of students as climate change leaders and sustainability advocates has a role to play in this regard. Draft recommendations of the UM President's Commission on Carbon Neutrality released in 2020 underscored that the University " . . . has a responsibility to ensure that each student, no matter their field of study, is prepared to engage with the global challenge of climate change and be part of the solution in their industry or chosen field of endeavor", [29] (p. 81).

2.2. Climate Change Pedagogies

Little has been established about effective strategies for teaching about climate change. Michel's 2020 article "Charting students' exposure to promising practices of teaching about sustainability across the higher education curriculum" noted that university policies regarding teaching about sustainability topics tend to be exposure-based rather than prescriptive in terms of pedagogy, and fields such as Education for Sustainability (EfS) also tend to focus more on concepts than teaching practices [5]. In another article, "Toward Conceptualizing Education for Sustainability in Higher Education", Michel suggested that the way that students experience EfS tends to be disparate instances of exposure to content focused on the development of sustainability knowledge, attitudes, and behaviors, falling short of what is necessary for many students to make connections between their education and their personal and professional goals [30]. EfS as it is commonly practiced may not be sufficient to develop sustainability leaders who can address climate change in the real world.

With an emphasis on content rather than delivery, practice-based skills such as leadership and applied problem-solving may prove more challenging for students to develop. Beyond teaching about climate change and ways to prevent and mitigate its effects, there is a need for the cultivation of CCL so that students can move from understanding to action. In a 2017 article on approaches to education for sustainable development in higher education, Lozano et al. underscored that "no single pedagogy alone reliably covers all competences" [7] (p. 10), and others have asserted that transformative sustainability pedagogy necessitates engagement of not only the head (e.g., concepts, knowledge), but also the hands and heart [31,32]. One benefit of a RLC as a site for teaching about sustainability and climate change is that the program structure connects formal classroom learning (which some might consider the "head") with residential life (the "hands" and

"heart"), allowing for cohesive coordination of approaches to teaching and learning across the student experience.

The literature on climate change education is sparser than that of sustainability education. Climate change education research has tended to incorporate aspects of leadership as competencies or outcomes of project-based learning [7,33,34]. In a 2017 article in *Environmental Education Research*, Monroe et al. identified four themes of effective climate change teaching strategies: deliberative discussions, interaction with scientists, addressing misconceptions, and implementing school or community projects [35]. While these strategies may be present in some RLCs, deliberative discussion and school or community projects are particularly common components. Kagawa and Selby (2010) defined the goal of climate change education as " . . . to think about what really and profoundly matters, to collectively envision a better future, and then to become practical visionaries in realizing that future", which centers leadership is an integral component [36] (p. 4–5).

2.3. Climate Change Leadership

Climate Change Leadership (CCL) has yet to have a unanimously agreed upon definition in the scholarship. While substantial research has been conducted on leadership more broadly, different theories have occupied prominence over time. Shriberg, former Education Director at the UM Graham Sustainability Institute, explored sustainability leadership particularly within the context of higher education [37–41]. He noted that leadership theory has historically come out of industrial or corporate settings, typically rooted in hierarchies and efficiencies [37]. Environmental movements and related leadership theories often evolve in opposition to such priorities, tending to be more decentralized with emphasis on conservation and stewardship [38]. Shriberg anticipated these fields were gradually moving towards one another. Shriberg also asserted that older leadership models are not equipped to address current challenges and called for the integration of sustainability skill sets into leadership criteria, which he defined as systems intelligence, visioning, humility, embracing and capitalizing on change, and orientation toward enlightened self-interest [37].

Colleges and universities have been interested in leadership models that focus on social responsibility and promotion of the common good, which informed the social change model of leadership development now common on many campuses developed by the Higher Education Research Institute of UCLA in 1993. This model conceptualized positive social change as a crucial element of leadership. The values which underpin it are often summarized as the 8 Cs: consciousness of self, congruence, commitment, collaboration, common purpose, controversy with civility, citizenship and change [37]. Key to this leadership model is its conception as a *process* rather than a skillset; an ongoing practice that evolves with the guidance of core values as the individual and society continue to change [37,42].

The social change model of leadership development lends itself well to CCL due to its focus on positive social change. It also pairs well with more environmental leadership approaches, such as eco-leadership or systems leadership, which tend to define leadership as relational, and better embodied as a way of being rather than a set of skills [39,41]. Environmental leadership models, however, tend to lack clear competencies and development pathways. This has presented higher education institutions seeking to develop sustainability programs with the choice to utilize leadership models that are not specific to their mission, or to develop or adapt less detailed sustainability-centered models to meet their program needs [40]. As a result, many student sustainability programs have grounded themselves in the social change or other models of leadership development that are not specific to the environment, while focusing on sustainability as the primary application [38]. In other cases, programs have focused on sustainability knowledge outcomes with leadership as a secondary [38]. Thus, the skills and competencies that college sustainability leadership programs aim to develop vary widely.

In a 2013 study, Shriberg and MacDonald interviewed the directors and analyzed materials of 20 sustainability leadership programs in higher education [38]. They noted

that many sustainability program directors were unable to articulate how their programs differed from traditional leadership programs. From their interviews, Shriberg and MacDonald compiled a list of best practices, including experiential learning (often group based), integrating disciplines (including the use of systems thinking), moving beyond sustainability knowledge, building community, moving beyond transformational leadership, change agent training, and acquiring specific skills (i.e., visioning, communication, self-assessment).

Methods for defining and assessing sustainability leadership need further development with special, intentional focus on CCL. Colleges and universities have worked to develop learning outcomes and competencies that work for their own sustainability leadership programs, cobbling together a range of frameworks with much overlap but without clear consensus. For the purposes of this article CCL was defined through combining and reorganizing EfS and leadership outcomes. Specifically, CCL was defined as *knowledge* (understanding of sustainability and climate change) and *behavior* (congruence and modeling actions that promote sustainability). Additionally, the EfS focus on attitudes was assessed through the more action-based metric of *engagement* (demonstrating leadership through community interaction and advocacy on sustainability or climate change issues).

2.4. Understanding Student Development in Environmental Context

Astin's 1993 Inputs-Environments-Outputs (I-E-O) model is commonly used to understand student development in environmental context [43]. In Astin's model, inputs take into account experiences, traits, and identities that students bring with them into their college experience including factors such as race, ethnicity, gender, college entrance exam scores, prior GPA, citizenship, and the level of education and income of the students' parents or guardians. After controlling for input characteristics, Astin's model highlights the importance of institutional environment on student outcomes, such as participation in academic programs or campus climate. In the present study residence was used to define three environment groups: SLE participants, other first year students living at the same residence hall as SLE (Oxford Houses), and first year students at other residence halls (excluding any participants in other RLCs). The outputs of interest were aspects of CCL defined as knowledge, behavior, and engagement. While Astin's I-E-O model typically has arrows pointing from inputs and environment to outputs, the present study indicates that outputs (such as sustainability advocacy) also link back to the environment, thus shaping the learning and residential context for neighboring students (see Figure 1).

Figure 1. Astin's I-E-O model, adapted to include a dashed line indicating the influence of outputs on environment. Used with permission of John Wiley & Sons, from *What matters in college?: four critical years revisited*, Alexander Astin, 1992; permission conveyed through Copyright Clearance Center, Inc.

3. Materials and Methods

3.1. Site and Sample

This study focused on the SLE, a RLC at UM, a public university that enrolls approximately 30,000 undergraduate students. SLE launched in 2016, building on seed funding from a student sustainability grant with financial support from the President's office specifically for the advancement of campus sustainability goals. SLE aims to develop " . . . lifelong leaders who will foster a cohesive culture of sustainability across campus . . . and establish a community of engaged learners which will continue to further sustainability efforts at

U-M and beyond", [44]. Incoming first year students with an interest in sustainability can apply to SLE, and each year approximately 25 are accepted and assigned rooms together in Oxford Houses residence hall. SLE students can be from any undergraduate school or major, and are required to enroll in a seminar course with the faculty director during Fall and Winter semesters. Table 1 describes survey sample sizes and response rates across terms.

Table 1. Sample sizes and response rates.

	SLE			Oxford Houses (Same Residence)			Other Residence Halls			
	Sample Size	**Responses**	**Response Rate**	**Sample Size**	**Responses**	**Response Rate**	**Sample Size**	**Responses**	**Response Rate**	**Total Responses**
Fall 2017	23	23	100%	315	99	31%	69	18	26%	140
Spring 2018	23	10	43%	315	35	11%	69	9	13%	54
Fall 2018	21	13	62%	314	75	24%	105	18	17%	106
Spring 2019	21	8	38%	314	61	19%	105	19	18%	88

The required SLE First Year Seminar acclimates students to the University, providing strategies for academic success and an introduction to sustainability and carbon neutrality activities on campus. Primary subject areas covered include food, water, waste, and energy, all from the lenses of climate change and environmental justice, and with a contextual focus on the campus and local area. Students travel together to different parts of campus and the community to observe operations and meet professionals engaged in sustainability work. This serves as a foundation as students later form "squads" to tackle sustainability challenges of their choice. While much of the learning for this course takes place in the classroom, it is applied on campus, most commonly at Oxford Houses where they live, creating a small and highly active community of engaged learners.

SLE places significant focus on the student and their first year experience, including support of transition to college, and the cultivation of awareness of self as well as relations to others. Some of this is facilitated outside the classroom through programs prior to the start of the semester, including shared summer reading, connections with returning student mentors, and welcome activities. Like many RLCs, SLE has incorporated many best practices from the social change model of leadership development, including meaningful relationships with faculty, community service (or service learning), and dialogue with peers are key factors in student leadership development, as identified in a 2010 article by Dugan & Komives [45]. During the school year the use of a regular newsletter, co-curricular events and other communications (social media, e-mail) serve to support wellbeing, healthy academic development, and community formation. Each of these opportunities are presented through the lens of sustainability (i.e., the importance of sustaining oneself), and discussions of climate change and environmental justice are woven across programming. While welcome events are planned by permanent SLE staff, programs are largely led by returning students known as SLE Peers once students arrive on campus.

Two of the authors on this study were SLE program faculty and staff, who have interests in the success of the SLE program.

3.2. Data Collection

Survey development and analysis also included leadership by graduate students in public health and higher education. The survey was developed in 2016 as a tool to evaluate multiple aspects of SLE, established that year. Aspects the team was most interested in understanding included sustainability and climate change knowledge, behaviors, and engagement as well as exposure to high impact learning practices and sense of inclusion on campus. In most cases, questions were replicated or modified from existing surveys, for validity and potential comparisons to larger data sets. The primary source was the Sustainability Cultural Indicators Program (SCIP), a survey developed at UM to assess sustainability culture and administered from 2012–2015 and in 2018 [46]. Other surveys referenced include University of Michigan Asks You (also known as UMAY, a survey on the undergraduate learning experience and campus climate) [47], the National Study of Living

Learning Programs [22], the Climate Change and the American Mind Survey conducted by the Yale Program on Climate Change Communication and George Mason University Center for Climate Change Communication (2015) [48], the Whitaker Assessment of Michigan Learning Communities [49], and UM Diversity, Equity & Inclusion Climate Survey [50]. Two versions of the survey were developed, one for when students entered college in the Fall and one for the end of their first year in the Spring. The Fall version had 21 questions as well as two sub-questions dependent on responses, and the Spring version included seven additional questions in order to observe changes over the academic year and gather information about opportunities and practices that students experienced.

Each academic year the survey went out to the same groups of first year students in Fall and Spring, including SLE participants, other first year students living in Oxford Houses (approximately 315 additional residents), and first year students in other residence halls. Students living in other residence halls were selected for demographically similar characteristics to SLE students with respect to available institutional data on sex and race and ethnicity. This study focused on responses collected over two academic years: Fall 2017–Spring 2018 and Fall 2018–Spring 2019. Due to the small size of the SLE cohort each year (approximately 25 students), Fall responses from each group in 2017 and 2018 were considered together, and this is also the case for Spring data sets from 2018 and 2019. Students under the age of 18 were not invited to complete the survey.

3.3. Data Analysis

In order to understand CCL among first year students at UM, this study used responses to a subset of questions about sustainability and climate change knowledge (questions 1, 2 and 10), behavior (questions 3, 4 and 5) and engagement (questions 11, 18 and 22). Survey items were recoded as needed to provide clearer analysis such that more sustainable responses would always be greater numbers (for example, 5), and less sustainable responses would be lower (for example, 1). The nature of the responses to these questions was ordinal, which means that the numbers themselves are arbitrary (for instance, instead of coding 5 as "A great deal" and 1 as "Nothing at all" in question 1, 1000 and −5 could have been used, respectively) but their order is not ("A great deal" is "more" than "Nothing at all"). Given this, conventional statistical tools (such as analysis of variance or ordinary least squares regression) and conventional statistics (such as averages and variances) were not appropriate. Instead, the ordered logit (OL) regression model was used to examine to what extent student CCL, defined by knowledge, behavior, and engagement, is influenced by participation in SLE or residency in Oxford Houses. This model assumed that there is a Linear Regression Model (LRM) for an unobservable variable ("knowledge", "behavior" and "engagement") which in turn affects the probabilities of students' answers to the questions, which was observed. Across all questions, the same two sets of explanatory variables were used for the LRM: residency and semester. The former is captured by two dummies, one for Oxford residents and another for SLE residents, leaving other campus residents as the reference group. The latter is captured by a dummy for the Spring semester, leaving the Fall as the reference period. In addition, the same regressions were run with an expanded set of explanatory variables that includes race/ethnicity, which was captured by the dummy variable URM, where URM stands for underrepresented minority student (Multiple Ethnicities, Asian/Pacific Islander, Hispanic/Latino, Black/African American, or American Indian/Alaskan Native). These categories for race/ethnicity are grouped together because of limited sample size.

A common problem with statistical analysis is that the results may reflect not only the effect of being part of SLE on CCL, but also the fact that students self-select into residency subgroups: it may be the case that students who demonstrated more CCL to begin with chose to be part of SLE. Thus, the correlations between their answers and their residency may not reflect the effect of SLE but pre-existing differences across students. To tease out the differential effect of being part of SLE (and also any spillovers from SLE to other Oxford residents—see below), difference-in-difference (DID) specification was used in the LRM.

DID was not possible for questions only included in the Spring survey (for example, about participation in student organizations). For these Spring-only questions (questions 17, 18, and 22) the interest was only in differences across residency groups and claims of causal relationships cannot be made.

Given that OL regressions were conducted, interpretation of results did not focus on the numbers themselves but on their statistical significance and signs. The signs of the regression estimates are not enough to infer the effect of the explanatory variables on the probabilities of choosing the intermediate answers, but they are enough for the extreme answers (1 "Nothing at all" and 5 "A great deal" in question 1). Therefore, this is where attention was focused. Specifically, a positive sign was associated with a higher chance of choosing the highest number (in the case of question 1, choosing 5 "A great deal") and a lower probability of choosing the lowest one (in the case of question 1, 1 "Nothing at all"). DID analysis allowed for differential changes in CCL across residential subgroups and, since it accounts for students' responses in the Fall (before their first year at UM), was able to distinguish between any pre-existing differences in CCL among students in each residential subgroup and the effect of their experiences in them.

Finally, in order to better understand other possible factors related to any differences in student responses, descriptive information was analyzed for questions related to student exposure to other sustainability learning opportunities (questions 16, 17, and 22). Table 2 provides a comprehensive list of the survey items used to measure sustainability knowledge, behavior, engagement, and exposure, their source, and the term(s) the survey was administered.

Table 2. CCL constructs and related survey questions.

Construct	Questions	Source	When Included
Knowledge	Q1. How much do you know about sustainability? *Response set: (5) A great deal, (4) A lot, (3) A moderate amount, (1) A little, (1) Nothing at all*	N/A	Fall & Spring
	Q2. How much do you know about the following at U-M? [Recycling glass, Recycling plastic, Recycling paper, Recycling electronic waste (i.e., computers, cell phones), Property Disposition services, Composting, Sustainable food)] *Response set: (4) A lot, (3) A moderate amount, (2) A little, (1) None at all*	SCIP	Fall & Spring
	Q10. How well could you explain the topic of global warming (climate change) to someone who didn't know about it—what's causing it or not, what are its potential consequences, etc.? *Response set: (4) Very well, (3) Fairly well, (2) A little bit, (1) Not at all*	SCIP	Fall & Spring
Behavior	Q3. "Sustainable food" can be defined as one or more of the following: locally-sourced, organic, from humanely-treated animals, antibiotic- and hormone-free, grass-fed, from sustainable fisheries, or fair-trade food. During the past year, about how much of your food choices were sustainable food? *Response set: (5) All/most, (4) More than half, (3) Half, (2) Less than half, (1) None, (0) I don't know*	SCIP modified	Fall & Spring
	Q4. During the past week, how often have you included meat as part of your daily diet? *Response set: (1) Daily/almost daily, (2) 3–4 days, (3) 1–2 days, (4) Never*	SCIP	Fall & Spring
	Q5. During the past year, how often did you do the following when you had the opportunity? [Turn off lights when leaving the room, Unplug electrical appliances when not using them, Use the power saving settings on my computer, Turn off my computer when not using, Use a motion sensor / "smart" power strip, Shop for things with minimal packaging, Shop in a second-hand store or online site such as eBay or Craigslist, when you have to buy something (e.g., clothing, furniture, or appliances), Compost food scraps, Buy products (besides food) that carry some type of eco-label or certification (e.g., lumber, organic cotton clothing, household cleaning products), Recycle electronic waste (i.e., computers, cell phones), Bring reusable bags to the grocery store)] *Response set: (4) Always/Most of the time, (3) Sometimes, (2) Rarely, (1) Never, (0) Not Applicable*	SCIP modified	Fall & Spring

Table 2. *Cont.*

Construct	Questions	Source	When Included
Engagement	Q11. During the past year, how often have you encouraged your friends to do the following things? [Walk, bike, or take the bus rather than drive, Buy locally sourced or sustainable food, Conserve water, Conserve electricity, Reuse or recycle containers or bags, Buy fewer things, Buy things that are better for the environment, Do something in order to reduce his/her greenhouse gas emissions] *Response set: (4) Frequently, (3) Sometimes, (2) Rarely, (1) Never, (0) Don't Know*	SCIP modified	Fall & Spring
	Q18. In the past academic year, how frequently did you: [Participate in service learning activities or trips, Partnered with campus or community partners on sustainability projects, Engage in leadership opportunities] *Response set: (5) Frequently, (4) Often, (3) Neither often nor infrequently, (2) Infrequently, (1) Never*	UMAY; NSLLP	Spring only
	Q22. How many clubs or organizations have you joined (attended more than once)? *Response set: (1) 0, (2) 1, (3) 2, (4) 3, (5) 4 or more*	UMAY modified	Spring only
Exposure	Q16. Who or what has been most influential in shaping your views about sustainability? *Response set: Media—readings, video, movies, TV, etc., Parents or other family members, Childhood experiences outdoors, K-12 teachers, U-M professors/instructors/courses, The Sustainable Living Experience (SLE) community, Friends or classmates (Outside of the SLE community), Other U-M activities, Other (please specify)*	SCIP	Fall & Spring
	Q17. Have you ever participated in any of the following at U-M? [RecycleMania, Kill-a-Watt, Earthfest, Harvest Festival at the Campus Farm, Zero Waste Events, e-Waste Events, Planet Blue Ambassadors Program, M Farmers Market, Earth Day related event, A U-M organization dealing with sustainability, A U-M course that addressed sustainability, Other] *Response set: (1) Yes, (0) No*	SCIP	Spring only
	Q22. How many clubs or organizations have you joined (attended more than once)? *Response set: (1) 0, (2) 1, (3) 2, (4) 3, (5) 4 or more*	UMAY modified	Spring only

4. Results

4.1. Descriptive Information

Tables 3 and 4 display demographic information for respondents organized by environmental groups. The demographic composition of student samples in SLE, Oxford Houses (excluding SLE), and other residence halls is available in Appendix A, Table A1. Findings indicated that students in SLE from 2017–2018 and 2018–2019 were overwhelmingly female and White. Approximately 77% of SLE students were female and 64% identified as White, and 77% of SLE respondents were female and 68% were White. 36% of SLE students from 2017–2019 identified as multiple ethnicities, Asian/Pacific Islander, Hispanic/Latino, Black/African American, or did not indicate their race or ethnicity. No SLE students identified as American Indian/Alaskan Native.

Table 3. Sex of respondents by residential group.

Residency	SEX		
	F	M	Total
Other residence halls	56	8	64
	87.50	12.50	100.00
Oxford	154	116	270
	57.04	42.96	100.00
SLE	42	12	54
	77.78	22.22	100.00
Total	252	136	388
	64.95	35.05	100.00

First row has frequencies and second row has row percentages.

Table 4. Race/ethnicity of respondents by residential group.

Residency	Race/Ethnicity						
	A/API	**B/AA**	**H/L**	**ME**	**NI**	**W**	**Total**
Other residence halls	10	0	3	8	10	33	64
	15.63	0.00	4.69	12.50	15.63	51.56	100.00
Oxford	40	8	16	12	9	185	270
	14.81	2.96	5.93	4.44	3.33	68.52	100.00
SLE	9	2	2	1	3	37	54
	16.67	3.70	3.70	1.85	5.56	68.52	100.00
Total	59	10	21	21	22	255	388
	15.21	2.58	5.41	5.41	5.67	65.72	100.00

First row has frequencies and second row has row percentages.

Oxford Houses had nearly identical representation of female and male students with both groups comprising 50% of the total sample (317 and 312 students, respectively). Similar to SLE students, Oxford residents were disproportionately White and represent 65% of the total sample, and 68% of Oxford respondents. The control group (students living in other residence halls) was selected for similar demographic composition as the SLE group. Approximately 79% of students in the control group were female and 63% were White. Respondents from other residence halls were 87.5% female and 51% were White. It should be noted that there were no responses for students living in other residence halls whose records indicated that they were Black/African American, although according to institutional data Black/African American students comprised 4.9% of UM first year undergraduates in 2017, and 4.7% in 2018 [51]. No respondents from any residential group were Native American/Alaskan Native students, who comprised 0.2% of incoming first year students in 2017 and 0.05% in 2018 [51].

4.2. Interpreting the Tables

The regression tables for each measure of CCL were organized as follows. The first two rows show the coefficients associated with students who lived in Oxford or SLE, which capture differences that were already present in the Fall (prior to their first year at UM) between students in Oxford or SLE and those who lived elsewhere. Therefore, to the extent that there is any self-selection into the SLE program, these coefficients captured it. Second, the coefficient associated with Spring captured how answers changed after the first academic year across all students at UM. This row reflects any university-wide effects associated with being at UM regardless of residential group. Finally, the coefficients associated with the interaction terms Oxford*Spring and SLE*Spring captured any additional change after the first year (on top of the university-wide effect) for students in both residential groups. In other words, they most likely reflect the effect of belonging to these residential groups, since any differences due to self-selection and any common trends across students at UM have already been separated. The SLE*Spring estimate is the closest to a causal effect of the program on CCL and, thus the focused interest. In addition, since students who lived in Oxford were not part of SLE but were exposed to SLE activities and participants, the term Oxford*Spring was included, which captured the spillovers of the program on CCL for neighboring students after their first year at UM. Due to their considerable length, additional regression tables (see Tables A2–A4) including race/ethnicity (see Table A1) were included in the Appendix A. Unless otherwise noted, all results detailed below were significant at the 1% level.

4.3. Sustainability Knowledge

In this study, knowledge about sustainability and climate change was measured by three questions: question 1 (Q1), question 2 (Q2), and question 10 (Q10). In Q1, students were asked to indicate on a 5-point Likert-type Scale how much they knew about sustainability (1 "Nothing at all"–5 "A great deal"). Q2 asked respondents how much they

knew about various sustainability operations at the University of Michigan (e.g., Recycling glass, composting) (1 "None at all"–4 "A lot"). For Q2, responses were considered together by using the mode across the seven sustainable operations sub-questions. In the case where there was a tie for the mode, three calculations were included: one that drops these responses, one using the minimum mode, and one using the maximum mode. Finally, Q10 asked respondents how well they could explain the topic of global warming to someone who did not know about it (1 "Not at all"–4 "Very well").

Table 5 shows results for this subset of knowledge questions. The regressions for Q1 indicated that SLE students at the beginning of the school year were more likely than students in Oxford or other residence halls to report knowing a great deal about sustainability rather than nothing at all (0.840 for SLE, 0.402 for Oxford, and 0 for others). The regressions for Q10 also indicated that at the beginning of the school year SLE students were more likely than students in Oxford or other residence halls to report higher abilities to explain global warming (0.163 for SLE, −0.0337 for Oxford, and 0 for others). For Q2, although Oxford residents were more likely to report knowing a lot about sustainability operations at UM than students in SLE or other residence halls, SLE students were still more likely to report knowing "a lot" than students in other residence halls (see Table 5 for set of three mode regressions).

Table 5. Regressions for Sustainability Knowledge Questions.

Variables	Q1	Q2	Q2_min	Q2_max	Q10
Oxford	0.402 ***	0.335 ***	0.136 ***	0.477 ***	−0.0337 ***
	(0.0195)	(0.0293)	(0.0174)	(0.0291)	(0.00325)
SLE	0.840 ***	0.282 ***	0.100 ***	0.349 ***	0.163 ***
	(0.0424)	(0.0280)	(0.0167)	(0.0227)	(0.00677)
Spring	0.615 ***	1.033 ***	0.721 ***	1.200 ***	−0.157 ***
	(0.0306)	(0.0948)	(0.0572)	(0.0816)	(0.00861)
Oxford*Spring	0.381 ***	0.116 ***	0.305 ***	−0.161 ***	0.759 ***
	(0.0274)	(0.00555)	(0.00949)	(0.00953)	(0.0577)
SLE*Spring	1.298 ***	0.543 ***	0.723 ***	0.392 ***	2.055 ***
	(0.0642)	(0.0239)	(0.0201)	(0.0172)	(0.179)
Observations	388	347	388	388	388

Robust standard errors in parentheses. *** $p < 0.01$. * denotes interaction between variables.

The Spring variable reflects the overall change in responses to sustainability knowledge questions after students experienced their first year at UM. Results for Q1 indicated that students were more likely to report knowing "a great deal" about sustainability on the Spring survey (0.615), and this effect was also visible for Q2 regarding campus sustainability operations such as recycling (see Table 5). For Q10, however, students were less likely to report that they were able to explain global warming "very well" after their first year at UM compared to the Fall (−0.157).

The final two rows of regressions reflect the interaction of being in the Oxford or SLE residence group and completing the first year at UM. Note that the SLE*Spring and Oxford*Spring effects are on top of the Spring and relative residential group effects. For example, the effect of being in the SLE residential group after the first year of college is reflected by combining the SLE, Spring and SLE*Spring effects (0.840 + 0.615 + 1.298 = 2.753 in the case of Q1). The same is true in the case of Oxford (0.402 + 0.615 + 0.381 = 1.298 in the case of Q1). Results indicated that the likelihood of SLE students reporting a higher level of sustainability knowledge across all three questions increased in the Spring much more than for students in other residential halls, with the greatest effect for Q10 regarding ability to explain global warming/climate change (Q10 2.055). Regressions for Oxford students also indicated increased likelihood of reporting higher sustainability knowledge for Q1 and Q10 (Q1 0.381, Q10 0.759), but were mixed for Q2 about campus sustainability operations depending on mode calculations (see Table 5).

The Appendix contains tables (see Table A1) with expanded sets of explanatory variables that includes race/ethnicity, which was captured by the binary variable URM. These have been included to better understand if the effects of the SLE RLC may be different for students who are White or who are URM. In the Spring, URM students in SLE increased their likelihood of reporting higher sustainability knowledge across all questions after their first year in the program by more than White students (Q1 1.272, Q2 0.893–1.090, Q10 1.350). This was also the case for URM students at Oxford for Q1 (0.735) and Q10 (0.336), however results for Q2 were mixed (see Table A2).

4.4. Sustainability Behavior

Sustainability behavior was measured by three questions: question 3 (Q3), question 4 (Q4), and question 5 (Q5). In Q3, students were asked to indicate how many of their food choices were sustainable during the past year (1 "None"–5 All/most). There was also a response option "I don't know", but it was not selected by any respondents. Q4 asked how often students included meat as part of their daily diet in the past week (1 "Daily/almost daily", 2 "3–4 days", 3 "1–2 days", 4 "Never"). Q5 asked how often students did a variety of eleven sustainable behaviors during the past year, such as composting food scraps, shopping for items with minimal packaging, or turning off lights when leaving a room (1 "Never"–4 "Always/Most of the time"). There was also a fifth option, "Not Applicable", which no students selected. For Q5, responses were considered together by using the mode across the eleven sustainable behavior sub-questions. In the case where there was a tie for the mode, three calculations were included: one that drops these responses, one that uses the minimum mode, and one that uses the maximum mode.

Table 6 shows results for this subset of sustainability behavior questions. The regressions for Q3 indicated that both SLE and Oxford students at the beginning of the school year were more likely than those in other residence halls to report that "all/most" of their food choices were sustainable rather than "none" (0.613 for SLE, 0.500 for Oxford, 0 for others). Regressions for Q4 indicated that at the beginning of the school year, SLE students were less likely than students in Oxford or in other residence halls to report including meat as a part of their daily diet (1.402 for SLE, −0.372 for Oxford, 0 for others). For Q5, SLE students were more likely to report more frequent sustainable behaviors in the Fall than Oxford students or other residents (see Table 6).

Table 6. Regressions for Sustainability Behavior Questions.

Variables	Q3	Q4	Q5	Q5_min	Q5_max
Oxford	0.500 ***	−0.372 ***	0.0902 ***	0.186 ***	0.0745 ***
	(0.0340)	(0.0147)	(0.00166)	(0.00205)	(0.00359)
SLE	0.613 ***	1.402 ***	1.139 ***	1.051 ***	0.988 ***
	(0.0365)	(0.102)	(0.0167)	(0.00972)	(0.0286)
Spring	1.041 ***	0.113 ***	−0.211 ***	−0.0415 ***	0.0124 **
	(0.0662)	(0.00181)	(0.000752)	(0.00163)	(0.00485)
Oxford*Spring	−0.313 ***	0.375 ***	0.687 ***	0.445 ***	0.441 ***
	(0.0213)	(0.0226)	(0.00573)	(0.00356)	(0.00671)
SLE*Spring	−0.414 ***	0.290 ***	0.591 ***	0.563 ***	0.321 ***
	(0.0156)	(0.0173)	(0.00873)	(0.00960)	(0.00711)
Observations	317	388	315	388	388

Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$. * denotes interaction between variables.

The Spring variable reflected the overall change in responses to sustainability behavior questions after the first year at UM. The regressions for all behavior questions indicated that students at UM were more likely to report more sustainable behaviors in Spring than they were in Fall regarding food, (Q3 1.041, Q4 0.113), but results were varied for the set of sustainable behaviors related to energy saving and waste reduction (see Table 6).

The final two rows of the regressions reflected the interaction of being in the Oxford or SLE residence group and completing the first year at UM (on top of the Spring and

initial residence group effects). The regression for Q3 suggested that although both SLE and Oxford students were more likely to report that all or most of their food choices were sustainable in the Spring than they were in the Fall (SLE 1.041–0.414 = 0.627, Oxford 1.041–0.313 = 0.728), their improvement was lower than that of students in other residence halls (1.041). Q4 regressions for SLE and Oxford students suggested that both increased their likelihood more than other students of reporting not including meat as a part of their daily diet between the Fall and the Spring (SLE 0.290, Oxford 0.375 on top of the increase of 0.113). For Q5, both SLE and Oxford students increased their likelihood of reporting engaging in sustainable waste and energy behaviors always or most of the time more than students in other residence halls (see Table 6).

Table A3 shows that in the Spring, URM students in SLE increased their likelihood of reporting high frequency sustainable food behaviors (Q3 3.068, Q4 2.532) more than White students in SLE and more than URM students in other residential halls. Results were mixed for Q5 (see Table A4). White students in SLE, however, showed a decrease in likelihood of reporting high frequency sustainable food behaviors in the Spring (Q3 −1.316, Q4 −0.393), and more likelihood of reporting sustainable energy or waste related behaviors (Q5, see Table A3).

4.5. Engagement

The CCL aspect of engagement was measured by three questions: question 11 (Q11), question 18 (Q18), and question 22 (Q22). In Q11, students were asked to indicate how often they encouraged friends to engage in a series of eight sustainable behaviors during the past year (1 "Never"–4 "Frequently"). Sub-questions included activities such as doing something to reduce his/her greenhouse gas emissions or conserving water. There was also a response option "Don't know", but it was not selected by any respondents. Q18 asked how frequently students participated in a range of opportunities indicative of leadership development, including service learning, working with campus or community partners on sustainability projects, and engaging in leadership opportunities (1 "Never"–5 "Frequently"). For Q11 and Q18 respectively, responses were considered together by using the mode across sub-questions. In the case where there was a tie for the mode, three calculations were included: one that drops these responses, one that uses the minimum mode, and one that uses the maximum mode. Q22 asked how many clubs or organizations students had joined (attended more than once).

Table 7 shows results for this subset of engagement questions. The regressions for Q11 indicated that SLE students at the beginning of the school year were more likely than students in other residential groups to report frequently encouraging friends to engage in sustainable behaviors (1.672 for SLE, 0.475 for Oxford). For Q18, both Oxford and SLE students were more likely to report participating in leadership development opportunities during their first year than other students (see Table 7). For Q22, results indicated that Oxford and SLE students were less likely to join clubs or organizations than first year students living elsewhere (SLE −0.213, Oxford −0.209).

The Spring effect was only calculable for Q11 about encouraging friends to engage in sustainability behaviors over the past year, since Q18 and Q22 were specific to campus engagement and could only be asked in the Spring. The overall campus effect for Q11 was mixed (see Table 7).

Likewise, the interaction between Spring and residence group could only be calculated for Q11 since it was asked both Fall and Spring. On top of campus-wide and initial residential group effects, additional positive effects were observed for Oxford (0.410) and SLE (0.834), indicating that after their first academic year Oxford and SLE students increased their likelihood of encouraging sustainable behaviors among friends more than students in other residence halls did.

Table A4, Q11 shows that URM students in SLE had a more positive change from Fall to Spring in terms of encouraging friends to engage in sustainable behaviors than White SLE students (see Table A4). Results were mixed for Q18 about exposure to leadership

development opportunities. For Q22, URM SLE students were more likely to join four or more clubs or organizations than White SLE students (URM 1.050).

Table 7. Regressions for Engagement Questions.

Variables	Q11	Q11_min	Q11_max	Q18	Q18_min	Q18_max	Q22
Oxford	0.475 ***	0.413 ***	0.315 ***	0.475 ***	0.493 ***	0.344 ***	−0.209 ***
	(0.0148)	(0.0203)	(0.0148)	(0.0244)	(0.0199)	(0.0191)	(0.0161)
SLE	1.672 ***	1.579 ***	1.446 ***	0.584 ***	0.179 ***	0.234 ***	−0.213 ***
	(0.0343)	(0.0545)	(0.0483)	(0.0180)	(0.00879)	(0.00833)	(0.0203)
Spring	0.123 ***	0.190 ***	−0.239 ***				
	(0.00838)	(0.0154)	(0.00345)				
Oxford*Spring	0.410 ***	0.220 ***	0.996 ***				
	(0.00172)	(0.00260)	(0.0271)				
SLE*Spring	0.834 ***	0.555 ***	0.887 ***				
	(0.00496)	(0.00891)	(0.00960)				
Observations	324	387	387	109	142	142	142

Robust standard errors in parentheses. *** $p < 0.01$. * denotes interaction between variables.

4.6. Exposure

While this study measured CCL as knowledge, behavior, and engagement, a series of questions that indicate exposure to other factors that might explain differences among residential groups were also considered. This information was gathered from question 16 (Q16), question 17 (Q17), and question 22 (Q22). Q16 asked students to indicate what had been most influential in shaping their views about sustainability, with responses such as media, childhood experiences outdoors, and SLE. Q17 asked about participation in campus organizations dealing with sustainability and courses that addressed sustainability. Q22, also considered as an aspect of engagement, asked how many clubs or organizations students had joined.

Figure 2 shows results for Q16 in Spring and Fall. When students started at UM in the Fall, media was reported as the most influential on sustainability views across residential groups. In Spring, media continued to be most influential for students living in Oxford or other residence halls, while SLE became the leading influence for SLE students.

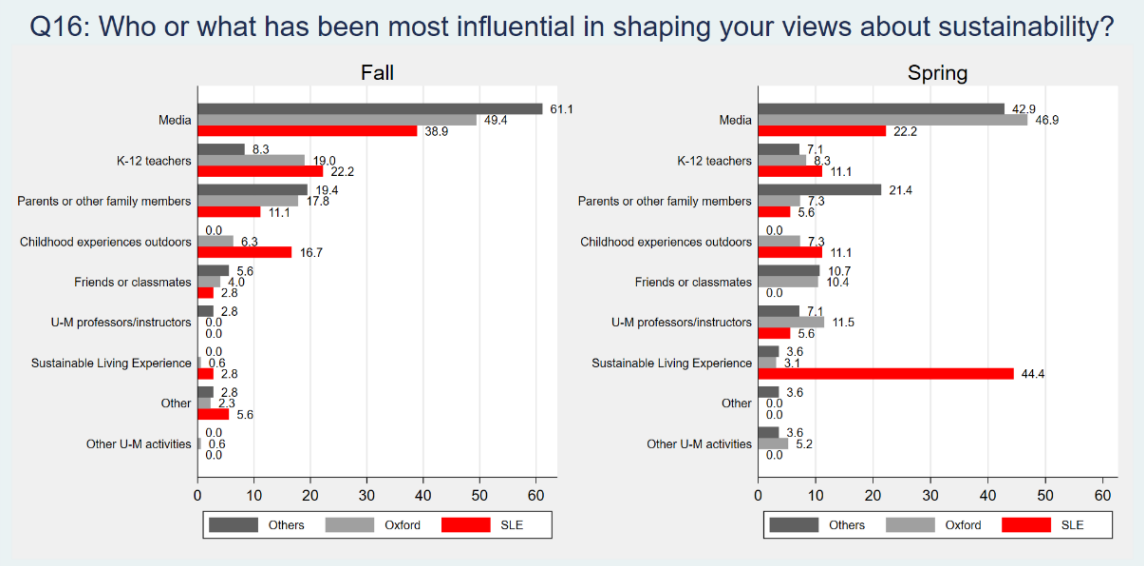

Figure 2. Influences on student sustainability views.

For Q17, SLE students reported less participation in organizations (or clubs) related to sustainability (11.1%). Students in Oxford and other residence halls reported similar

participation in these types of organizations, 24% and 25% respectively (Figure 3). SLE students were more likely to report participation in courses that addressed sustainability (33.3%, see Figure 4), however it should be noted that all SLE students are required to take a sustainability seminar course and it is unclear whether students considered this course when indicating their responses. 20.8% of Oxford residents indicated taking sustainability-related coursework, as well as 10.7% of other students.

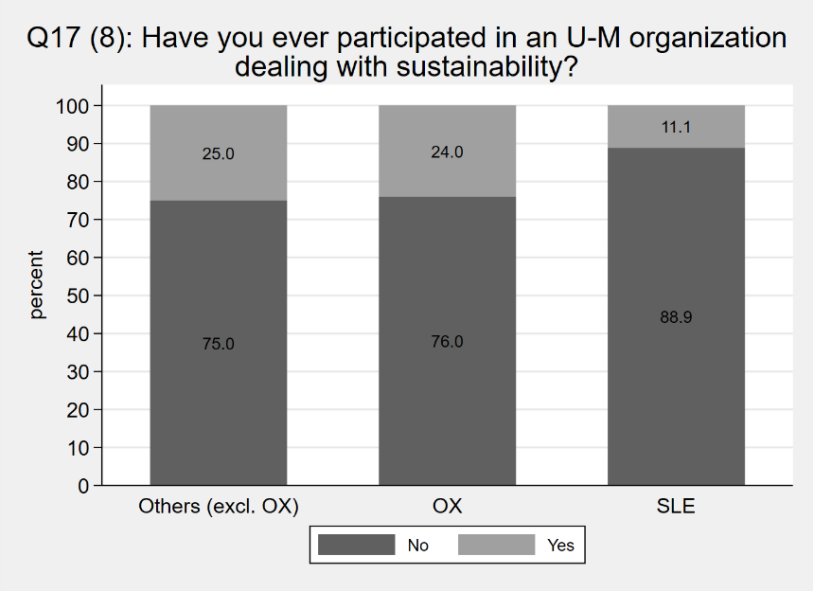

Figure 3. Participation in campus organizations dealing with sustainability by residence group.

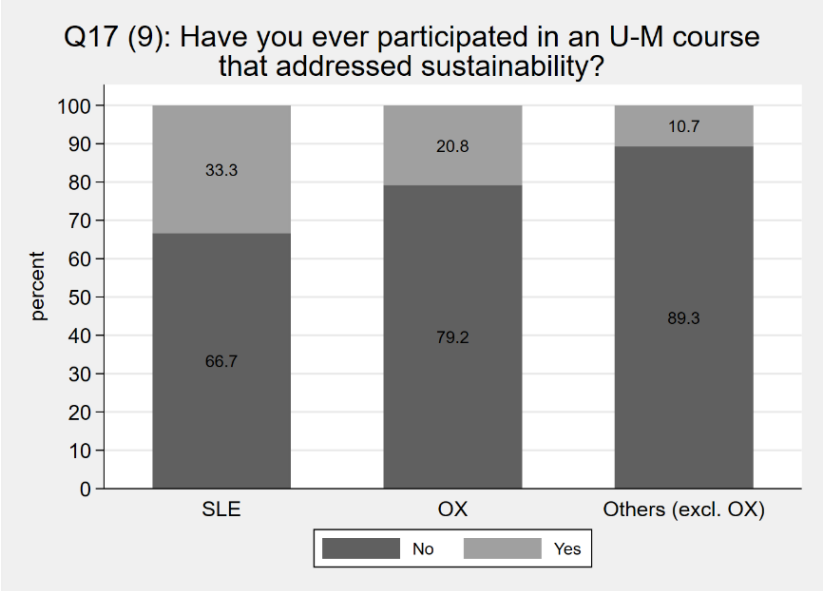

Figure 4. Participation in courses that address sustainability by residence group.

Results for Q22, about participating in UM clubs or organizations, are shown in Figure 5. While a larger percentage of SLE students joined four or more clubs or organizations (22.2%) and a lower percentage joined zero (5.6%), less SLE students overall were involved in two or more organizations (61.1%) than other students at Oxford (67.7%) or in other residence halls (75%).

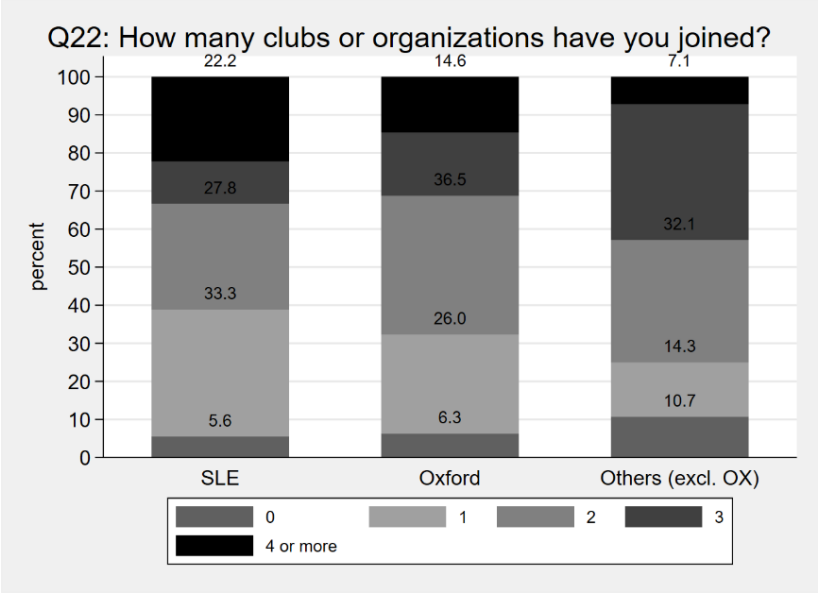

Figure 5. Participation in clubs or organizations by residence group.

5. Limitations

This study was limited to one institutional context, which makes it difficult to generalize beyond public institutions with similar characteristics. Furthermore, the research team had the bias of being affiliated with the University of Michigan and SLE program. Data available for this study regarding student inputs was limited to institutional data on race/ethnicity, sex, and residence of respondents. Although there were a few students who responded to both Fall and Spring surveys, the data is not a panel, but repeated cross-sections, which raises the issue of whether there was a systematic change in the composition of respondents between Fall and Spring (self-selection into filling the survey). The sex information available was limited to male and female, restricting the ability of students to provide non-binary responses. Options for reporting race and ethnicity were also limited, and further information is not available for students who indicated multiple ethnicities. Small sample sizes and varying response rates across groups and years restricted the ability to conduct further analysis in terms of race/ethnicity. For this study, authors chose to focus on environment groups (SLE, Oxford, other residence halls), time (Fall and Spring), and race/ethnicity (White, URM), and further analysis of CCL outcomes should be conducted with regards to sex, gender, and fuller consideration of intersectionality if data becomes available. Information regarding other input factors that may affect the answers to the questions in the survey, such as first generation student status, incoming GPA, test scores, sexual orientation, or socio-economic status, were not available to include in the analysis. If any of these unobserved variables were also associated with race/ethnicity or residence, results could be biased.

6. Discussion

Analysis of this multiyear survey at UM has provided preliminary insight on aspects of CCL, including self-reported sustainability and climate change knowledge, behavior, and engagement among first year students. By surveying the same groups of students at the beginning (Fall) and end (Spring) of each academic year, changes could be observed over time. The groups of students surveyed, including SLE participants, neighboring Oxford residents, and first year students living in other residence halls, allowed for examination of the impact of the RLC as a pedagogical model for CCL development, a topic which has not previously been studied.

6.1. Sustainability Knowledge

Student participants in SLE reported higher levels of CCL related knowledge than students in Oxford or other residence halls when they began college in the Fall. This is not surprising, as SLE students expressed an interest in sustainability and climate change when they applied to join the RLC. These effects increased for SLE students from Fall to Spring, and in particular for URM SLE students. It is also of note that Oxford residents who lived alongside the SLE program exhibited higher sustainability knowledge in the Spring than students in other residence halls. These effects are on top of a notable campus-wide effect which indicated positive change from Fall to Spring in terms of general sustainability knowledge (Q1) and campus sustainability (Q2), and an overall negative campus-wide effect from Fall to Spring in ability to explain global warming/climate change (Q10). This negative effect in campus-wide ability of first year students to explain climate change could be explained by students learning more about the issue in college and realizing that climate change may be more complicated than they thought when college began. Results demonstrated positive effects for sustainability knowledge questions for both SLE and Oxford residential groups when compared to other residence halls.

6.2. Sustainability Behavior

Sustainable Living Experience students also reported higher baseline sustainability behaviors when they began school in the Fall. By Spring, both SLE and Oxford residents were more likely to report never consuming meat (Q4) and more likely to report a range of other sustainable energy and waste behaviors than students in other residence halls (Q5). However, the effect of being in SLE and Oxford residential groups had a negative effect on the sustainable food choices they reported making in the Spring (Q3 SLE −0.414, Oxford −0.313), while the overall campus effect was positive (Q3 1.041). This could be explained by limited choices in the dining hall. The dining hall available at Oxford happens to be small compared to other dining halls on campus, which could explain negative effects in sustainable food choices for students who live there. It is important to note that for URM SLE students there was a positive effect on sustainable food choices in the Spring, and that the combined respective effects for SLE and Oxford for Q3 were still positive (SLE 1.240, Oxford 1.228, Campus 1.041) regarding frequency of sustainable food choices. Being in SLE or Oxford residential group after the first year of college had a positive effect on some sustainable behaviors (decreased meat consumption, waste, and energy use), but not necessarily frequency of sustainable food choices.

6.3. Engagement

As indicated in the literature about sustainability leadership and climate change education, *knowledge* about sustainability and climate change and exhibiting sustainable *behaviors* alone do not make a Climate Change Leader [4,30–33,36,38]. The *engagement* aspect assessed in the survey is important to better understand how students are interacting with others on Climate Change and sustainability related issues. Q11 may be the most directly indicative of CCL, which asked respondents how often they encouraged their friends to engage in a range of sustainability behaviors, such as conserving water or doing something to reduce their greenhouse gas emissions. Positive Spring effects were observed for both SLE and Oxford residential groups (see Table 7), suggesting that SLE may have had spillover effects on the Oxford community. A positive effect for Q11 in Spring was observed in particular for URM SLE students (see Table A4).

Q18 and Q22 also included general indicators of leadership, such as getting involved on campus. Both Oxford and SLE students were less likely than students living elsewhere to join a large amount of student organizations (Q22), but more likely to report participating in leadership development opportunities (service learning, working with campus or community partners on sustainability projects, taking on leadership with a student organization). SLE offers opportunities for service learning, and the* seminar requires working with campus or community partners on sustainability projects, so it makes sense

that more positive effects were observed for SLE students. The observable higher likelihood of participation in these types of leadership development opportunities for Oxford residents could be an effect of SLE (students are exposed and encouraged to participate in these opportunities on campus), or an additional explanation why Oxford residents may exhibit higher CCL.

6.4. Exposure

Using DID in the LRM for questions that had both Fall and Spring data (all except for Q17, Q18, and Q22) allowed for estimation of the differential effect for being in particular residential groups (SLE, Oxford, other residence halls), as well as being White or URM (see Tables A2–A4). However, because students have not yet joined campus sustainability organizations in the Fall, regressions could not be run to see if students in the SLE group were inherently more likely to join these organizations, which could be a factor in observed differences in CCL. Additional exposure questions allowed for better clarification of such potential factors. In the case of sustainability organizations, SLE students reported participating in less than students in Oxford or other residence halls. There was also a question about participation in campus clubs or organizations since that could relate to engagement aspects of CCL (such as taking on leadership roles). There was not much variation across the three groups, however, and students in other residence halls reported participating in the most clubs or organizations.

SLE students did, however, report taking more sustainability classes than those in Oxford or other residence halls, which is a likely factor contributing to increased CCL over the school year. There is not Fall data for this since most UM students have not taken classes yet when they begin their first year. However, because all SLE students are required to enroll in a sustainability seminar together both Fall and Winter semesters, this question was not particularly useful for comparison (100% of SLE students should report sustainability coursework, rather than the 33.3% observed). For example, if the only sustainability coursework SLE students are taking is indeed the SLE course, then other sustainability coursework could not be a contributor to CCL. Furthermore, EfS and other climate change education literature has clearly indicated that experiences inside the classroom alone are not enough to prepare effective climate change leaders, ready to apply what they know about sustainability to take action [4,30–33,36,38].

In the Fall students across residential groups reported media as being the most influential on their sustainability views, which is also true in Spring for Oxford and other residence halls. However, for SLE students in Spring SLE became the most influential, while media remained consistent for the other two groups. This indicated that SLE could be a significant factor in changes in CCL for SLE students.

As for Oxford students, they did not appear to join more sustainability organizations than other students on campus, so this is not a likely explanation for positive differences in CCL compared to students in other residence halls. However, nearly twice as many Oxford residents reported enrolling in a sustainability course (20.8% of Oxford residents, compared to 10.7% of students in other residence halls). This higher number for Oxford residents could be a spillover effect of SLE. It also could be completely unrelated to the program, and an alternate or additional explanation for why Oxford residents generally showed more positive changes in CCL than students in other residence halls.

6.5. Potential Impacts of Sustainability RLCs on College Campuses

The present study found that for CCL knowledge and engagement measures, SLE students reported the highest levels of CCL coming into college, and the greatest increases over the school year when compared to students in other residence halls. These effects were significant to the 1% level, strongly suggesting that the SLE residence group was the reason for these greater effects, and often larger for URM SLE students. Pronounced gains in positive outcomes for URM students were observed in several previous RLC studies [9,18,20,23]. Positive effects were also observed for Oxford residents, suggesting that the presence of the

SLE community may have an impact on neighboring students, which is in alignment with previous research on RLCs indicating potential spillover effects [18,22,24–27]. In the case of Oxford, these effects were not necessarily larger for URM students.

Climate change leadership behavior appears to be more complicated, as SLE students entered their first year reporting higher CCL behaviors, yet in some cases they increased less than that of students in other residence halls (sustainable food choices), or showed a smaller positive effect than that observed for Oxford residents (such as less frequent meat consumption). The Oxford residential group also showed smaller effect in sustainable food choices over the school year in comparison to other students, but positive effects for reduced waste, meat consumption, and energy use. As previously noted, since these unexpected relative negative effects in sustainable food choices over the year were observed for all students using the Oxford dining hall and not for other students on campus, it is possible that this smaller dining operation itself is contributing to the effect. It is also possible that dining operations on campus, which pride themselves in their sustainability efforts, were functioning as a sort of equalizer in sustainable food choices. Whatever the explanation, it is apparent that the effect of existing campus sustainability infrastructure on overall campus sustainability behaviors should not be overlooked. In the case of SLE students, who were already more likely to engage in these behaviors when they arrive on campus, infrastructure and operations may in some cases reduce their ability to live sustainably. However, for the majority of first year students in other residence halls, the overall campus effect was positive. For the approximately 300 non-SLE Oxford residents, the positive campus effect compounded with what authors suggest is the spillover SLE effect indicated particularly promising positive results.

Previous studies have suggested a connection between RLCs and positive outcomes often associated with campus Diversity, Equity and Inclusion (DEI) initiatives [18,22,24–27]. Results of this study suggested that the SLE RLC may in some cases have even greater positive effects for URM participants, which is important to consider at a Predominantly White Institution such as UM where URM students have reported less sense of belonging and less satisfaction with their ability to thrive and grow [50]. Furthermore, this study indicated that RLCs may have ripple effects that support additional campus priorities such as carbon neutrality.

While separate initiatives, stewards of both DEI and carbon neutrality goals at UM recognized the essential and significant task of cultivating a campus culture that prioritizes and supports their realization. Quantifying campus sustainability culture is a difficult task, one that researchers Marans and Callewaert at the Institute for Social Research at UM have been undertaking for several years [46]. Their Sustainability Cultural Indicators Program questionnaire was used to develop the survey used in this study, and further research needs to be conducted to better understand the results of this study within the context of the larger SCIP data set. This study suggested that the SLE RLC may have a positive relationship with aspects of CCL not only among program participants, which currently number less than fifty each year, but also among neighboring residents of Oxford Houses, which includes an additional capacity for approximately 300 students. Students participating in SLE plan and participate in many sustainability activities in their residence hall, which other Oxford residents are typically welcome to join. These activities have included watching environmental documentaries in the dining hall, sustainability trivia, and preparing community dinners together. SLE has also partnered with UM Housing staff to pilot the inclusion of a sustainability representative on Hall Council, supporting a student leadership position that brings a sustainability perspective to Oxford-wide programming. The presence of an environmentally-themed RLC may also signal to students a campus priority on carbon neutrality, with potential to promote a campus culture of sustainability.

7. Implications

7.1. Implications for Developing CCL at UM

Climate change leaders do not work alone, but must collaborate with others to work towards making a positive difference. Sustainability-themed RLCs such as SLE embed participants within a community of peers similarly committed to addressing climate change and other sustainability issues. This study suggested that even a small RLC such as SLE may have interactions with the larger residence hall community related to positive CCL outcomes. Furthermore, because sustainability RLCs such as SLE tend to support first year students, the positive CCL outcomes observed for participants and neighboring students may continue to have impacts on campus throughout remaining years of college study. There is a need for more longitudinal research that follows students throughout their college career. The sample in the present study was small and predominantly White and female, yet in some cases greater CCL outcomes were observed for URM SLE students. Additional research with larger and more diverse samples is needed to properly conduct intersectional analysis. There should also be further inquiry into the ability of intentionally designed high impact learning practices to provide equitable higher education experiences for all [23,52,53]. Campus-wide positive effects were also observed after the first year, with increased campus-wide effects for CCL in terms of knowledge and food choices. Further research is needed to better conceptualize how the overall campus climate and infrastructure supports or detracts from student CCL development.

While attention and research has previously been devoted to student outcomes related to classroom and curricula [5,7,33–35], this research suggested that achieving carbon neutrality and cultivating students as change agents requires attention in other arenas as well. In particular, the realm of student affairs, known at UM as Student Life—which includes housing, dining, recreational sports, counseling, multicultural centers and more—needs to be better understood and integrated with campus carbon neutrality efforts, climate change curricula, and CCL development. Early research has begun to tease out possible interactions between factors, such as sustainability coursework, co-curricular programs, race/ethnicity, and sex, on CCL development, but more is needed [54].

7.2. Implications for Climate Change Teaching at UM and Beyond

Research on climate change education often focuses on exposure and content rather than process or practice (e.g., [5,7,33]). There seems to be some consensus in the literature that present practices of climate change teaching are not enough to develop the competent climate change leaders needed to address this global challenge [4–7,30]. This study provided an examination of one RLC as a strategy for climate change teaching, which weaves together formal academic requirements and informal learning outside the classroom. SLE also uses the campus as a living learning laboratory and as a core component of climate change education and leadership development, engaging small groups of students in applied sustainability projects in their own lives and community. These strategies align with the research on the goals and effective practices of teaching about sustainability [5,7,33–36]. This study supported previous research in the field (e.g., [4,30–33,36,38]) that has indicated that effective climate change pedagogy needs to extend beyond the classroom. RLCs allow for cohesive integration of academic concepts with student lives and should be considered and researched further for their potential as effective approaches to climate change teaching on college campuses. For institutions such as UM where a sustainability-themed RLC already exists, the research suggested that there is merit to more thorough analysis and integration of these programs with campus sustainability and carbon neutrality goals.

8. Conclusions

Colleges and universities have a great capacity to act to address climate change, and at schools such as the UM that have a mission to serve the public good, they have a duty to do so. The UM commits itself to "developing leaders and citizens who will challenge the present and enrich the future", [55] and like many campuses offers several programs

related to sustainability and climate change leadership [56–58]. Research on what CCL is and how to develop it, however, lags behind practice and the already present effects of global climate change. This study has made modest contributions to understanding one sustainability-focused RLC as a model for CCL pedagogy, indicating that there are greater positive changes in many CCL outcomes for participants and neighboring students. However, more research is needed, in particular to define CCL and survey institutions of higher education for best practices. Due to the application of CCL in real-world settings, it may prove important for further research and assessments to include collaborations between academic and co-curricular partners at diverse institutions. RLCs are not the only way of bringing climate change lessons to bear outside the classroom, and other models should be explored.

Author Contributions: Conceptualization, E.C., J.C. and J.T.; Data curation, L.M.E.B.; Formal analysis, L.M.E.B.; Methodology, E.C., J.C., L.M.E.B. and J.T.; Writing—original draft, E.C.; Writing—review & editing, E.C., J.C., L.M.E.B. and J.T. All authors have read and agreed to the published version of the manuscript.

Funding: This research received funding from the UM School for Environment and Sustainability (SEAS) Themes Grant.

Institutional Review Board Statement: Institutional Review Board determination of Not Regulated, HUM00129292 4 April 2017.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Conflicts of Interest: The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

Appendix A

Table A1. Sample demographics by environmental group.

	SLE			
2017–2018	Female	16	Male	7
	White—not of Hispanic origin	11	White—not of Hispanic origin	2
	Not Indicated	2	Not Indicated	1
	Asian/Pacific Islander	1	Asian/Pacific Islander	3
	Hispanic/Latino	0	Hispanic/Latino	0
	Black/African American	0	Black/African American	1
	American Indian/Alaskan Native	0	American Indian/Alaskan Native	0
	Multiple Ethnicities	2	Multiple Ethnicities	0
2018–2019	Female	18	Male	3
	White—not of Hispanic origin	14	White—not of Hispanic origin	1
	Not Indicated	0	Not Indicated	0
	Asian/Pacific Islander	3	Asian/Pacific Islander	1
	Hispanic/Latino	1	Hispanic/Latino	1
	Black/African American	0	Black/African American	0
	American Indian/Alaskan Native	0	American Indian/Alaskan Native	0
	Multiple Ethnicities	0	Multiple Ethnicities	0
TOTALS	Female	34	Male	10
	White—not of Hispanic origin	25	White—not of Hispanic origin	3
	Not Indicated	2	Not Indicated	1
	Asian/Pacific Islander	4	Asian/Pacific Islander	4
	Hispanic/Latino	1	Hispanic/Latino	1
	Black/African American	0	Black/African American	1
	American Indian/Alaskan Native	0	American Indian/Alaskan Native	0
	Multiple Ethnicities	2	Multiple Ethnicities	0
	Total URM students	7	Total URM students	6

Table A1. *Cont.*

SLE				
Oxford Houses (residence hall where SLE is located)				
2017–2018	Female	157	Male	158
	White—not of Hispanic origin	108	White—not of Hispanic origin	104
	Not Indicated	5	Not Indicated	11
	Asian/Pacific Islander	13	Asian/Pacific Islander	27
	Hispanic/Latino	15	Hispanic/Latino	10
	Black/African American	10	Black/African American	2
	American Indian/Alaskan Native	0	American Indian/Alaskan Native	1
	Multiple Ethnicities	6	Multiple Ethnicities	3
2018–2019	Female	160	Male	154
	White—not of Hispanic origin	97	White—not of Hispanic origin	99
	Not Indicated	7	Not Indicated	8
	Asian/Pacific Islander	25	Asian/Pacific Islander	25
	Hispanic/Latino	15	Hispanic/Latino	13
	Black/African American	8	Black/African American	3
	American Indian/Alaskan Native	0	American Indian/Alaskan Native	0
	Multiple Ethnicities	8	Multiple Ethnicities	6
TOTALS	Female	317	Male	312
	White—not of Hispanic origin	205	White—not of Hispanic origin	203
	Not Indicated	12	Not Indicated	19
	Asian/Pacific Islander	38	Asian/Pacific Islander	52
	Hispanic/Latino	30	Hispanic/Latino	23
	Black/African American	18	Black/African American	5
	American Indian/Alaskan Native	0	American Indian/Alaskan Native	1
	Multiple Ethnicities	14	Multiple Ethnicities	9
	Total URM students	100	Total URM Students	90
Other residence halls				
2017–2018	Female	48	Male	21
	White—not of Hispanic origin	33	White—not of Hispanic origin	6
	Not Indicated	6	Not Indicated	3
	Asian/Pacific Islander	3	Asian/Pacific Islander	9
	Hispanic/Latino	0	Hispanic/Latino	0
	Black/African American	0	Black/African American	3
	American Indian/Alaskan Native	0	American Indian/Alaskan Native	0
	Multiple Ethnicities	6	Multiple Ethnicities	0
2018–2019	Female	90	Male	15
	White—not of Hispanic origin	62	White—not of Hispanic origin	8
	Not Indicated	3	Not Indicated	0
	Asian/Pacific Islander	11	Asian/Pacific Islander	5
	Hispanic/Latino	7	Hispanic/Latino	2
	Black/African American	1	Black/African American	0
	American Indian/Alaskan Native	0	American Indian/Alaskan Native	0
	Multiple Ethnicities	6	Multiple Ethnicities	0
TOTALS	Female	138	Male	36
	White—not of Hispanic origin	95	White—not of Hispanic origin	14
	Not Indicated	9	Not Indicated	3
	Asian/Pacific Islander	14	Asian/Pacific Islander	14
	Hispanic/Latino	7	Hispanic/Latino	2
	Black/African American	1	Black/African American	3
	American Indian/Alaskan Native	0	American Indian/Alaskan Native	0
	Multiple Ethnicities	12	Multiple Ethnicities	0
	Total URM students	34	Total URM students	19

Table A2. Expanded Regressions for Sustainability Knowledge Questions.

Variables	Q1	Q2	Q2_min	Q2_max	Q10
Oxford	0.669 ***	0.870 ***	0.570 ***	0.871 ***	−0.0606 ***
	(0.0402)	(0.0681)	(0.0424)	(0.0479)	(0.00196)
SLE	1.445 ***	0.888 ***	0.585 ***	0.925 ***	0.357 ***
	(0.101)	(0.0718)	(0.0449)	(0.0527)	(0.0189)
URM	0.474 ***	0.772 ***	0.902 ***	0.562 ***	−0.258 ***
	(0.0279)	(0.0673)	(0.0565)	(0.0326)	(0.00153)
Spring	0.989 ***	1.133 ***	0.895 ***	1.115 ***	0.0137 **
	(0.0638)	(0.0906)	(0.0525)	(0.0644)	(0.00582)
Oxford*URM	−0.378 ***	−0.917 ***	−1.002 ***	−0.498 ***	0.455 ***
	(0.0212)	(0.0870)	(0.0708)	(0.0317)	(0.00854)
SLE*URM	−2.226 ***	−1.077 ***	−1.059 ***	−0.897 ***	−0.00656
	(0.149)	(0.0988)	(0.0772)	(0.0572)	(0.0150)
Oxford*Spring	0.0872 ***	0.308 ***	0.276 ***	0.240 ***	0.522 ***
	(0.0176)	(0.0420)	(0.00822)	(0.0410)	(0.0250)
SLE*Spring	1.044 ***	0.247 ***	0.430 ***	0.170 ***	1.482 ***
	(0.0294)	(0.0222)	(0.00461)	(0.0245)	(0.103)
URM*Spring	−1.065 ***	−0.421 ***	−0.815 ***	−0.000213	−0.276 ***
	(0.0689)	(0.0287)	(0.0320)	(0.0134)	(0.0160)
Oxford*URM*Spring	0.735 ***	−0.650 ***	0.198 ***	−1.048 ***	0.336 ***
	(0.0498)	(0.0666)	(0.00464)	(0.0947)	(0.0218)
SLE*URM*Spring	1.272 ***	1.068 ***	1.090 ***	0.893 ***	1.350 ***
	(0.125)	(0.0966)	(0.0641)	(0.0589)	(0.0509)
Observations	366	326	366	366	366

Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$. * denotes interaction between variables.

Table A3. Expanded Regressions for Sustainability Behavior Questions.

Variables	q3	q4	q5	q5_min	q5_max
Oxford	0.847 ***	−0.936 ***	0.621 ***	0.481 ***	0.454 ***
	(0.0675)	(0.0301)	(0.00828)	(0.00636)	(0.0104)
SLE	1.110 ***	1.905 ***	1.290 ***	1.227 ***	0.988 ***
	(0.0790)	(0.0810)	(0.0166)	(0.0168)	(0.0230)
URM	1.278 ***	−0.587 ***	0.789 ***	0.400 ***	0.526 ***
	(0.0972)	(0.0235)	(0.00943)	(0.00569)	(0.0104)
Spring	1.599 ***	−0.0682 ***	0.0120 ***	0.145 ***	−0.121 ***
	(0.130)	(0.0127)	(0.00177)	(0.00144)	(0.00301)
Oxford*URM	−0.826 ***	1.036 ***	−1.040 ***	−0.513 ***	−0.532 ***
	(0.0534)	(0.0354)	(0.0144)	(0.00883)	(0.0123)
SLE*URM	−1.257 ***	−2.345 ***	0.302 ***	−0.486 ***	0.333 ***
	(0.0754)	(0.0904)	(0.00332)	(0.00504)	(0.00711)
Oxford*Spring	−0.764 ***	0.679 ***	0.562 ***	0.449 ***	0.693 ***
	(0.0690)	(0.0318)	(0.00733)	(0.00702)	(0.0118)
SLE*Spring	−1.316 ***	−0.393 ***	0.458 ***	0.452 ***	0.645 ***
	(0.0935)	(0.0138)	(0.00785)	(0.0113)	(0.0140)
URM*Spring	−2.113 ***	0.215 ***		−0.820 ***	0.0602 ***
	(0.168)	(0.0159)		(0.00907)	(0.00357)
Oxford*URM*Spring	1.509 ***	−0.637 ***	−0.493 ***	0.0835 ***	−0.660 ***
	(0.118)	(0.0349)	(0.00416)	(0.00367)	(0.00991)
SLE*URM*Spring	3.068 ***	2.532 ***	−0.234 ***	0.792 ***	−0.446 ***
	(0.198)	(0.107)	(0.00688)	(0.00245)	(0.0120)
Observations	300	366	297	366	366

Robust standard errors in parentheses. *** $p < 0.01$. * denotes interaction between variables.

Table A4. Expanded Regressions for Sustainability Engagement Questions.

Variables	Q11	Q11_min	Q11_max	Q18	Q18_min	Q18_max	Q22
Oxford	0.0147 ***	0.123 ***	0.122 ***	0.846 ***	0.480 ***	0.878 ***	0.0800 ***
	(0.00122)	(0.00900)	(0.00209)	(0.0948)	(0.0545)	(0.0815)	(0.00882)
SLE	1.756 ***	1.603 ***	1.791 ***	0.750 ***	0.191 ***	0.685 ***	−0.286 ***
	(0.0223)	(0.0625)	(0.0231)	(0.0773)	(0.0200)	(0.0485)	(0.0102)
URM	−0.928 ***	−0.676 ***	−0.852 ***	0.569 ***	0.00451	0.907 ***	0.609 ***
	(0.0110)	(0.0401)	(0.00646)	(0.0800)	(0.0317)	(0.0961)	(0.0106)
Spring	−0.0686 ***	0.0140 **	−0.246 ***				
	(0.00262)	(0.00700)	(0.000821)				
Oxford*URM	1.122 ***	0.843 ***	1.096 ***	−0.449 ***	0.0854 ***	−0.754 ***	−0.458 ***
	(0.0122)	(0.0439)	(0.00804)	(0.0708)	(0.0279)	(0.0790)	(0.00759)
SLE*URM	−0.326 ***	−0.0958 ***	−0.496 ***	0.202 ***	0.171 ***	−0.365 ***	1.050 ***
	(0.0138)	(0.0228)	(0.0164)	(0.0181)	(0.0284)	(0.0307)	(0.0675)
Oxford*SLE	0.902 ***	0.802 ***	1.263 ***				
	(0.00983)	(0.0265)	(0.0159)				
SLE*Oxford	0.555 ***	0.350 ***	0.377 ***				
	(0.000896)	(0.00225)	(0.000444)				
URM*Spring	0.118 ***	0.0868 ***	0.170 ***				
	(0.00777)	(0.0147)	(0.00580)				
Oxford*URM*Spring	−1.057 ***	−1.415 ***	−0.924 ***				
	(0.0119)	(0.0724)	(0.00783)				
SLE*URM*Spring	1.332 ***	1.468 ***	1.617 ***				
	(0.0237)	(0.0147)	(0.0277)				
Observations	306	365	365	104	136	136	136

Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$. * denotes interaction between variables.

References

1. Cortese, A.D. The Critical Role of Higher Education in Creating a Sustainable Future. *Plan. High. Educ.* **2003**, *31*, 15–22.
2. Buckler, C.; Creech, H. *Shaping the Future We Want: UN Decade of Education for Sustainable Development*; Final Report; United Nations Educational, Scientific and Cultural Organization (UNESCO): Paris, France, 2014.
3. Barth, M.; Rieckmann, M. State of the Art in Research on Higher Education for Sustainable Development. In *Routledge Handbook of Higher Education for Sustainable Development*; Barth, M., Michelsen, G., Rieckmann, M., Thomas, I., Eds.; Routledge: London, UK, 2015; pp. 124–137.
4. Singleton, J. Head, heart and hands model for transformative learning: Place as context for changing sustainability values. *J. Sustain. Educ.* **2015**, *9*, 1.
5. Michel, J.O. Charting students' exposure to promising practices of teaching about sustainability across the higher education curriculum. *Teach. High. Educ.* **2020**, *25*, 787–813. [CrossRef]
6. Hiser, K. *Coping with Climate (and COVID-19) Anxiety for Yourself and in the (Virtual) Classroom*; Association for the Advancement of Sustainability: Philadelphia, PA, USA, 2020.
7. Lozano, R.; Id, M.; Merrill, M.; Sammalisto, K.; Ceulemans, K.; Lozano, F. Connecting Competences and Pedagogical Approaches for Sustainable Development in Higher Education: A Literature Review and Framework Proposal. *Sustainability* **2017**, *9*, 1889. [CrossRef]
8. Tinto, V.; Goodsell-Love, A. Building community. *Lib. Educ.* **1993**, *79*, 16–21.
9. Engstrom, C.; Tinto, V. Learning better together: The impact of learning communities on the persistence of low-income students. *Oppor. Matters* **2008**, *1*, 5–21.
10. Shapiro, N.S.; Levine, J.H. *Creating Learning Communities: A Practical Guide to Winning Support, Organizing for Change, and Implementing Programs*; Jossey-Bass: San Francisco, CA, USA, 1999.
11. Knight, W. Learning Communities and First Year Programs: Lessons for Planners. *Plan. High. Educ. J.* **2003**, *31*, 5–12.
12. Pike, G.R.; Schroeder, C.C.; Berry, T.R. Enhancing the educational impact of residence halls: The relationship between residential learning communities and first-year college experiences and persistence. *J. Coll. Stud. Dev.* **1997**, *38*, 609–621.
13. Inkelas, K.K.; Weisman, J.L. Different by Design: An Examination of Student Outcomes Among Participants in Three Types of Living-Learning Programs. *J. Coll. Stud. Dev.* **2003**, *44*, 335–368. [CrossRef]
14. Inkelas, K.K.; Daver, Z.; Vogt, K.; Brown Leonard, J. Living-learning programs and first-generation college students' academic and social transition to college. *Res. High. Educ.* **2007**, *48*, 403–434. [CrossRef]
15. Gabelnick, F.; MacGregor, J.; Matthews, R.S.; Smith, B.L. Learning Communities: Creating Connections among Students, Faculty, and Disciplines. In *New Directions for Teaching and Learning*; Jossey-Bass: San Francisco, CA, USA, 1990; p. 41.

16. Pike, G.R. The effects of residential learning communities and traditional residential living arrangements on educational gains during the first year of college. *J. Coll. Stud. Dev.* **1999**, *40*, 269–283.
17. Pasque, P.A.; Murphy, R. The Intersections of Living-Learning Programs and Social Identity as Factors of Academic Achievement and Intellectual Engagement. *J. Coll. Stud. Dev.* **2005**, *46*, 429–441. [CrossRef]
18. Kuh, G.D. *High-Impact Educational Practices: What They Are, Who Has Access to Them, and Why They Matter*; Association of American Colleges and Universities: Washington, DC, USA, 2008.
19. Stassen, M. Student Outcomes: The Impact of Varying Living-Learning Community Models. *Res. High. Educ.* **2003**, *44*, 581–613. [CrossRef]
20. Mayhew, M.J.; Rockenbach, A.B.; Bowman, N.A.; Seifert, T.A.; Wolniak, G.C.; Pascarella, E.T.; Terenzini, P.T. *How College Affects Students. 21st Century Evidence that Higher Education Works*; John Wiley & Sons, Incorporated: Newark, NJ, USA, 2016; Volume 3.
21. Brower, A.M.; Inkelas, K.K. Living-learning programs: One high-impact educational practice we now know a lot about. *Lib. Educ.* **2010**, *96*, 36–43.
22. Inkelas, K.K.; Szelényi, K.; Soldner, M.; Brower, A.M. *National Study of Living-Learning Programs: 2007 Report of Findings*; University of Maryland: College Park, MD, USA, 2008.
23. Finley, A.; McNair, T. *Assessing Underserved Students' Engagement in High-Impact Practices. With an Assessing Equity in High-Impact Practices Toolkit*; Educational Resources Information Center (USA) Association of American Colleges and Universities: Washington, DC, USA, 2013.
24. Inkelas, K.K. *A Tide on Which All Boats Rise: The Effects of Living Learning Programs on Outcomes at the University of Michigan, Report*; University Housing: Ann Arbor, MI, USA, 1999.
25. Longerbeam, S.; Inkelas, K.K.; Brower, A.M. Second-hand benefits: Student outcomes in residence halls with living-learning programs. *J. Coll. Univ. Stud. Hous.* **2007**, *34*, 20–30.
26. Kuh, G.D. Experiences That Matter: Enhancing Student Learning and Success. In *National Survey of Student Engagement Annual Report 2007*; Center for Postsecondary Research, Indiana University: Bloomington, IN, USA, 2007.
27. Fink, J.E.; Hummel, M.L. With Educational Benefits for All: Campus Inclusion Through Learning Communities Designed for Underserved Student Populations. In *New Directions for Student Services*; Benjamin, M., Ed.; John Wiley & Sons, Incorporated: San Francisco, CA, USA, 2015; pp. 37–38.
28. Campus Sustainability Goals. Available online: http://sustainability.umich.edu/campus-goals (accessed on 13 January 2021).
29. President's Commission on Carbon Neutrality. *Draft Report and Recommendations*; University of Michigan: Ann Arbor, MI, USA, 2020; Available online: https://sustainability.umich.edu/media/files/pccn/pccn_draft_final_report.pdf (accessed on 13 January 2021).
30. Michel, J.O. Toward Conceptualizing Education for Sustainability in Higher Education. *New Dir. Teach. Learn. About Sustain.* **2020**, *161*, 23–33. [CrossRef]
31. Orr, D.W. Ecological Literacy: Education and the Transition to a Postmodern World. In *SUNY Series in Constructive Postmodern Thought*; State University of New York Press: Albany, NY, USA, 1992.
32. Sipos, Y.; Battisti, B.; Grimm, K. Achieving Transformative Sustainability Learning: Engaging Head, Hands and Heart. *Int. J. Sustain. High. Educ.* **2008**, *9*, 68–86. [CrossRef]
33. Wiek, A.; Withycombe, L.; Redman, C.L. Key competencies in sustainability: A reference framework for academic program development. *Sustain. Sci.* **2011**, *6*, 203–218. [CrossRef]
34. Evans, T.L. Competencies and Pedagogies for Sustainability Education: A Roadmap for Sustainability Studies Program Development in Colleges and Universities. *Sustainability* **2019**, *11*, 5526. [CrossRef]
35. Monroe, M.C.; Plate, R.R.; Oxarart, A.; Bowers, A.; Chaves, W.A. Identifying effective climate change education strategies: A systematic review of the research. *Environ. Educ. Res.* **2017**, *25*, 791–812. [CrossRef]
36. Kagawa, F.; Selby, D. Introduction. In *Education and Climate Change: Living and Learning in Interesting Times*; Kagawa, F., Selby, D., Eds.; Taylor & Francis Group: Milton Park, UK, 2010; pp. 1–11.
37. Shriberg, M. Sustainability Leadership as 21st Century Leadership. In *Environmental Leadership: A Reference Handbook*; Gallagher, D.R., Ed.; SAGE Publications, Inc.: Thousand Oaks, CA, USA, 2012; pp. 469–478.
38. Shriberg, M.; MacDonald, L. Sustainability Leadership Programs: Emerging Goals, Methods & Best Practices. *J. Sustain. Educ.* **2013**, *5*, 1–21.
39. Shriberg, M.; Harris, K. Building sustainability change management and leadership skills in students: Lessons learned from 'sustainability and the campus' at the university of Michigan. *J. Environ. Stud. Sci.* **2012**, *2*, 154–164. [CrossRef]
40. Shriberg, M. Building Sustainability Leaders: A framework to prepare students to thrive on complexity and lead transformative changes. In *Sustainable Development at Universities: New Horizons*; Leal Filho, W., Ed.; Peter Lang: New York, NY, USA, 2008.
41. Shriberg, M.; Schwimmer, S.; MacDonald, L. University of Michigan's Sustainability Scholars Program: Empowering leaders. *Sustainability* **2013**, *6*, 259–264. [CrossRef]
42. Komives, S.R.; Wagner, W. *Leadership for a Better World: Understanding the Social Change Model of Leadership Development*, 2nd ed.; Jossey-Bass: San Francisco, CA, USA, 2009.
43. Astin, A.W. *What Matters in College? Four Critical Years Revisited*; Jossey-Bass: San Francisco, CA, USA, 1993.
44. Sustainable Living Experience. Available online: https://lsa.umich.edu/sustainable-living (accessed on 11 December 2020).

45. Dugan, J.P.; Komives, S.R. Influences on College Students' Capacities for Socially Responsible Leadership. *J. Coll. Stud. Dev.* **2010**, *51*, 525–549. [CrossRef]
46. SCIP Materials. Available online: http://graham.umich.edu/campus/scip/materials (accessed on 13 January 2021).
47. Selected UMAY Findings. Available online: https://obp.umich.edu/surveys-research/umay/selected-umay-findings (accessed on 13 January 2021).
48. Leiserowitz, A.; Maibach, E.; Roser-Renouf, C.; Feinberg, G.; Rosenthal, S. *Climate Change in the American Mind: October, 2015*; Yale University and George Mason University: New Haven, CT, USA, 2015; Yale Program on Climate Change Communication; Available online: https://climatecommunication.yale.edu/wp-content/uploads/2015/11/Climate-Change-American-Mind-October-20151.pdf (accessed on 13 January 2021).
49. Michigan Learning Communities Collaborative Assessment Project. Available online: http://www.crlt.umich.edu/node/85672 (accessed on 13 January 2021).
50. University of Michigan. Results of the 2016 University of Michigan Student Campus Climate Survey on Diversity, Equity and Inclusion. Available online: https://diversity.umich.edu/wp-content/uploads/2017/11/dei-student-report-final.pdf (accessed on 9 January 2022).
51. University of Michigan Office of the Registrar. Enrollment Reports. Available online: https://ro.umich.edu/reports/enrollment (accessed on 16 January 2022).
52. Harper, S.R.; Quaye, S.J. *Student Engagement in Higher Education: Theoretical Perspectives and Practical Approaches for Diverse Populations*; Routledge: New York, NY, USA, 2009.
53. Harper, S.R. Race-conscious student engagement practices and the equitable distribution of enriching educational experiences. *Lib. Educ.* **2009**, *95*, 38–45.
54. Henderson, T.S.; Michel, J.O.; Bryan, A.; Canosa, E.; Gamalski, C.; Jones, K.; Moghtader, J. An Exploration of the Relationship Between Sustainability-Related Involvement and Learning in Higher Education. *Sustainability* **2022**, *14*, 5506. [CrossRef]
55. University of Michigan Office of the President. Mission. Available online: https://president.umich.edu/about/mission (accessed on 22 September 2022).
56. Planet Blue Campus: University of Michigan. Planet Blue Student Leaders. Available online: https://planetblue.umich.edu/campus/about/partners/student-life/about-us/pbsl (accessed on 22 September 2022).
57. Graham Sustainability Institute. Dow Sustainability Fellows Program. Available online: https://graham.umich.edu/dow (accessed on 22 September 2022).
58. Graham Sustainability Institute. Graham Sustainability Scholars Program. Available online: https://graham.umich.edu/scholars (accessed on 22 September 2022).