

Assessment of sustainability awareness and practice in a campus community

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Abstract

Purpose – This research paper aims to evaluate the sustainability knowledge and background of students, staff and faculty regarding current university sustainability practices and individual behaviors at Central Michigan University (CMU); to compare sustainability background and knowledge based on academic discipline of enrollment or employment; and to assess sustainability awareness and interest of the campus community to guide future sustainability initiatives and resources at CMU.

Design/methodology/approach – An electronic cross-sectional survey was used to collect anonymous responses through Qualtrics, and then results were analyzed through SPSS. Analyses were performed based on the academic structures at CMU.

Findings – This research has found that students in STEM fields are more inclined to have pro-sustainability attitudes, knowledge and behaviors, compared to those studying the arts and business. Additionally, results indicate that there is a significant difference in knowledge between the students, and the staff and faculty respondents regarding sustainability knowledge and application, with the staff and faculty consistently demonstrating more pro-sustainability knowledge and behavior.

Originality/value – While research has previously been conducted on sustainability attitudes and behaviors, this research is unique because it ties sustainability knowledge to academic discipline.



Additionally, it serves to gauge which sustainability programs and topics members of the campus community are most interested in, and which areas they are most willing to support.

Keywords Sustainability, Environment, Recycling, Higher education, Waste, Energy, Food, Education, Engagement, Student engagement

Paper type Research paper

Introduction

In the USA and beyond, a growing number of college students are interested in addressing sustainability challenges (AASHE, 2015). Students care about the health of the global environment and hope to see their collegiate institutions pursue environmental sustainability solutions (Speer *et al.*, 2020). Therefore, it is of utmost importance that higher education institutions are able to adapt to changing perceptions and environments by providing students, staff and faculty with the opportunity to contribute to sustainability planning and education in their respective communities.

Central Michigan University (CMU) is a public Carnegie R^2 Research Institution enrolling 11,303 main-campus students in the fall of 2022 (CMU Fall End of Semester Enrollment Statistics, 2022). CMU has six primary undergraduate academic colleges, including the College of Arts and Media, the College of Business Administration, the College of Education and Human Services, The Herbert H. and Grace A. Dow College of Health Professions (Health Professions), the College of Liberal Arts and Social Sciences and the College of Science and Engineering. They collectively house 170 undergraduate majors and 117 other graduate, PhD and certificate programs (CMU Academics, 2023).

At CMU, sustainability policy and action has largely been a product of administrative decisions with limited student and stakeholder input. In 2015, CMU started a dining hall composting program, which engaged local partners, and served to divert 330 tons of food waste from landfills on an annual basis. This program earned numerous national recognitions, including a 2019 WasteWise “College and University Partner of the Year” award from the United States Environmental Protection Agency (USEPA) and the 2022 Campus Race to Zero Waste Large Campus “Organics Category Champion” award from RecycleMania Inc. Likewise, sustainability actions and operations within CMU Facilities Management earned CMU the 2015 “Excellence in Recycling Award” from the Michigan Department of Environmental Quality and Governor’s Recycling Council, the “Sustainability Innovation Award in Facilities Management” from the Association of Physical Plant Administrators and the 2021 “Brian Yeoman Sustainable Procurement Award” from the National Association of Educational Procurement.

Despite these successes, CMU has only recently begun to engage students, staff and faculty in sustainability efforts through the student-led establishment of Central Sustainability in 2020, which now functions as the office of sustainability at CMU. This office has since earned CMU a “Gold” STARS rating from the Association for the Advancement of Sustainability in Higher Education (AASHE), the “Student Sustainability Leadership Award” from AASHE and the “Sustainability Public Education” award from the USEPA. The new existence and recent success of this student-led office has demonstrated that students at CMU have an interest in sustainability investment and infrastructure.

While many of these prior accomplishments are rooted in university programs in recycling, composting and energy use, CMU leadership has not engaged stakeholders in the associated sustainability decision-making process. Sustainability decisions at CMU have far-reaching impacts on several parties, including but not limited to the City of Mount Pleasant and its approximately 21,000 residents (United States Census Bureau, 2020). Other

impacted stakeholders include the Saginaw Chippewa Indian Tribe, on-campus and global- (virtual) campus students, staff and faculty and prospective, current and future campus community members and alumni. While the boundaries of the Saginaw Chippewa Indian Tribe are not within Mount Pleasant, the adjacent territory is home to over 3,000 enrolled members, all of whom are impacted by sustainability initiatives at CMU ([CMU Partners in Progress, 2023](#)). With this in mind, it is vital that campus community members can engage in the sustainability decision-making process, as its impacts have far-reaching environmental, social, fiscal and cultural consequences.

Other similar studies have engaged students through knowledge- and action-based assessments of sustainability culture in higher education environments. Previous studies have demonstrated that demographic factors such as gender, hometown, first-generation status and academic discipline can have a positive or negative impact on sustainability knowledge and behavior ([Sahin et al., 2012](#)). Additionally, these studies have indicated that non-demographic factors such as media usage, prior experiences and external influences can have a positive or negative impact on sustainability knowledge and behavior ([Sahin et al., 2012](#)). Most notably, it is evident that students, while demonstrating that sustainability and addressing climate change is important to them, do not have the specific knowledge or awareness of sustainability themes and opportunities around them to positively engage with building a more sustainable world ([Al-Zohbi and Pilotti, 2023](#)). Students are unprepared to address sustainability in their respective career fields, often because they lack opportunities to engage in sustainable development within their campus communities ([Msengi et al., 2019](#); [Alsaati et al., 2020](#)). Overall, the consensus of prior research indicates that the higher education environment presents an opportunity for students to gain sustainability knowledge and practice associated actions, and thus institutions such as CMU must capitalize on these opportunities. Although the CMU survey is only a one-year assessment, it will provide insight into changing sustainability knowledge and behaviors over a four-year collegiate experience.

As higher education institutions often have the capacity to be leaders in research and innovation, universities must recognize their role in sustainable development. A 2016 study identified that universities are broadly lacking in community-wide sustainable development, likely because of an overwhelming focus on internal curriculum and programming ([Shiel et al., 2016](#)). As growing issues such as climate change present major challenges to society, our students, who are the leaders of the future, need to be informed about sustainability challenges and solutions.

Additional existing literature has demonstrated that public higher education systems are often behind private education systems in sustainability education and curriculum. In a 2022 study based in Pakistan, it was found that private education systems were more successful than public education systems in making students cognizant of sustainability and sustainable development ([Jillani et al., 2022](#)). Additionally, sustainability can be heavily influenced by senior leadership, managerial leadership and individualistic influences ([Stoughton and Ludema, 2012](#)). This means that varying environments can have varying influences on sustainability behaviors, and therefore, it is important to understand the unique challenges and benefits to implementing sustainability solutions and education in a given area.

In a university setting, it is unclear what the primary influences are on student sustainability knowledge. Potential sources and influences could be peers, student background, staff and faculty or academic area of discipline, among others. A 2011 study found that staff and faculty play a crucial yet hidden role in campus sustainability, and therefore, these populations must be mobilized to accomplish sustainability goals ([Brinkhurst et al., 2011](#)). With this in mind, it is important to gauge whether or not staff and faculty are equipped with the necessary sustainability knowledge and awareness to positively influence the campus

community. Therefore, this study has three primary objectives. First, it will serve to evaluate the sustainability knowledge and background of students, staff and faculty regarding current university sustainability practices and individual behaviors. Second, it will compare sustainability background and knowledge based on academic discipline of enrollment or employment. Finally, it will assess sustainability awareness and interest of the campus community to guide future sustainability initiatives and resources at CMU.

Methods

Survey development

Two surveys were developed – a student survey and a staff and faculty survey. These were developed and administered through the Qualtrics XM Platform (Qualtrics, 2022). This is because “Qualtrics Research Core XM is CMU’s enterprise-level survey and data collection tool for both research and administrative projects. It offers users the ability to create surveys, collect responses, and analyze data” (CMU Technology at CMU, 2023). Qualtrics is accessible for anyone with an electronic device via email, and free to use for the students, staff and faculty at CMU. Additionally, Qualtrics enables survey administrators to easily and anonymously export results to analysis platforms such as Excel, or SPSS among others. Each survey consisted of four primary sections: Demographics, Sustainability Background, Sustainability Activities at CMU and a Sustainability Engagement section. These were developed through consultation with CMU Human Resources, Central Sustainability and the CMU Office for Institutional Diversity, Equity and Inclusion. The surveys underwent the Institutional Review Board approval process during January of 2022. The student survey totaled 25 questions and was predominately “yes” and “no” questions. Similarly, the staff and faculty survey totaled 23 questions and was predominantly “yes” and “no” questions, with variations in the demographics section (Table 1).

Question	Choices	Student	Staff and faculty
What is your gender identity	Male	107 (27.3)	78 (27.6)
	Female	267 (68.1)	201 (71.0)
	Other	18 (3.7)	4 (1.4)
What is your class standing?	Underclassmen	162 (41.3)	–
	Upperclassmen	230 (58.7)	–
How long have you been employed at CMU?	0–5 years	–	71 (25.1)
	Over 5–10 years	–	63 (22.3)
	Over 10–15 years	–	46 (16.3)
	More than 15 years	–	103 (36.4)
What category best describes your employment/career interest?	The arts and media	47 (12.0)	10 (3.6)
	Business	44 (11.2)	18 (6.5)
	Education and human services	70 (17.8)	23 (8.3)
	Health professions	75 (19.1)	37 (13.3)
	Liberal arts and social sciences	68 (17.3)	33 (11.9)
	Science and engineering	85 (21.6)	30 (10.8)
	Other	4 (1.0)	127 (45.6)
Are you a first-generation college student?	Yes	99 (25.2)	–
	No/Not sure	294 (74.8)	–
What best describes your current living situation?	On-campus	187 (47.6)	–
	Off-campus	206 (52.4)	–

Source: Author’s own work

Table 1.
Demographic data of
student and staff and
faculty respondents

Survey distribution

Once developed, the survey was first administered to students, then to staff and faculty, and all responses were collected anonymously through the Qualtrics XM Platform (Qualtrics, 2022). For the student sample, researchers requested a random anonymous sample comprised of 25% of the undergraduate student body attending classes at the CMU main campus from the university Office of the Registrar. During February 2022, after this sample was obtained, the survey was electronically distributed, using Qualtrics, to undergraduate students, totaling 2,350 individuals, then redistributed once a week for three more consecutive weeks, garnering 392 student responses (16.6% response rate). During March 2022, the staff and faculty survey was distributed to all faculty through the Faculty Association union, and to all staff through CMU Human Resources. The survey reached 1,286 individuals and was then redistributed two weeks later, garnering a total of 283 staff and faculty responses (22.0% response rate). For both the student, and staff and faculty samples, the survey and results are subject to selection bias and nonresponse bias, because the sample population could elect to not take the survey (Qualtrics, 2023).

Data analysis

The two survey data sets were analyzed separately through IBM SPSS Statistics version 28.0.0.0 (IBM Corp, 2021), then comparatively and collectively through a combined-results data set. Demographic data was compared to the 17 questions addressing sustainability background and sustainability actions at CMU for both surveys (students, and staff and faculty) (Table 1). Comparisons between students, and staff and faculty regarding sustainability background and knowledge were conducted using Pearson Chi-square tests (Table 2). Next, student and staff and faculty responses were combined and pooled into each of their academic colleges as appropriate, including arts and media, business, education and human services, health professions, liberal arts and social sciences and science and engineering. These university divisions were then compared and tested for significance (Table 3). Finally, sustainability engagement and written response questions were compared and analyzed. All significant results were found using a chi-squared analysis in IBM SPSS Statistics version 28.0.0.0 (IBM Corp, 2021).

Results

The frequencies and results reported below reflect valid cases for each question and exclude missing cases in the event that respondents skipped individual questions. Additionally, due to selection bias and non-response bias, these results and associated statistical analysis are not fully representative of all student, staff and faculty members at CMU, because individuals from the initial sample could elect to not complete the survey (Qualtrics, 2023).

Demographics

Students. From the student survey, 392 of 2,350 students whom the survey was administered to submitted responses (16.6%). Of these, 27.3% identified as male, and 68.1% identified as female. Additionally, 58.7% identified as upperclassmen, 52.4% of student respondents identified as living off-campus, and 25.2% identified as first-generation college students. Academically, the College of Business and College of Arts and Media acquired the least respondents, comprising 11.2% and 12.0% of student responses, respectively. Above that, the College of Education and Human Services and College of Liberal Arts and Social Sciences comprised 17.8% and 17.3% of student responses, respectively. Academic groups with the most responses included the College of Science and Engineering and College of Health Professions, comprising 21.6%, and 19.1% of responses, respectively (Table 1).

Question	Choices	Student	Staff and faculty	Chi-squared <i>p</i> -value
<i>Part 1: Sustainability background</i>				
Prior to taking this survey, have you heard of the term, "sustainability?"	Yes	363 (98.6)	271 (98.5)	0.643**
	No/Not sure	5 (1.4)	4 (1.4)	
Do you think your individual actions can make a difference toward sustainability issues?	Yes	285 (77.4)	249 (90.5)	<0.001*
	No/Not sure	83 (22.6)	26 (9.5)	
Did you recycle prior to attending CMU?	Yes	304 (82.6)	231 (84.0)	0.479
	No/Not sure	64 (17.4)	44 (16.0)	
Do you recycle currently?	Yes	272 (73.9)	261 (95.3)	<0.001*
	No/Not sure	96 (26.1)	13 (4.7)	
Do you feel informed about what can and cannot be recycled at CMU?	Yes	230 (62.5)	198 (72.3)	<0.001*
	No/Not sure	138 (37.5)	76 (27.8)	
Do you actively compost?	Yes	39 (10.6)	103 (37.5)	<0.001*
	No/Not sure	328 (89.4)	172 (62.5)	
Do you feel informed about what can and cannot be composted at CMU?	Yes	81 (22.0)	53 (19.3)	0.506
	No/Not sure	287 (78.0)	221 (80.7)	
Do you actively try to minimize your food waste?	Yes	259 (70.4)	229 (83.3)	<0.001*
	No/Not sure	109 (29.6)	46 (16.7)	
Do you actively try to minimize your water and energy usage?	Yes	250 (68.1)	242 (88.0)	<0.001*
	No/Not sure	117 (31.9)	33 (12.0)	
Do you actively try to minimize your solid waste?	Yes	233 (63.3)	237 (86.2)	<0.001*
	No/Not sure	135 (36.7)	38 (13.8)	
<i>Part 2: Sustainability at CMU</i>				
Have you seen recycling bins in campus buildings?	Yes	351 (98.0)	263 (92.0)	0.667**
	No/Not sure	7 (2.0)	4 (1.4)	
Are you aware that CMU campus dining has a composting program?	Yes	142 (39.7)	112 (39.2)	0.565
	No/Not sure	216 (60.3)	155 (54.2)	
Have you seen water bottle refill stations in campus buildings?	Yes	347 (96.9)	261 (97.8)	0.53
	No/Not sure	11 (3.1)	6 (2.2)	
Did you know that CMU derives 25% of its energy from wind power?	Yes	29 (8.1)	22 (8.2)	0.958
	No/Not sure	328 (91.9)	245 (91.8)	
Did you know that CMU derives 75% of its energy from coal?	Yes	24 (6.7)	34 (12.7)	0.01*
	No/Not sure	334 (93.3)	233 (87.3)	
Did you know that CMU prevents approximately 40% of its solid waste from being sent to landfills?	Yes	24 (6.7)	49 (18.4)	<0.001*
	No/Not sure	334 (93.3)	217 (81.6)	
Did you know that CMU is a member of the Association for the Advancement of Sustainability in Higher Education?	Yes	68 (19.0)	74 (27.7)	0.011*
	No/Not sure	289 (81.0)	193 (72.3)	

Notes: *Indicates significance at or below $p = 0.05$; **indicates questions that could not be tested for significance due to low response counts

Source: Author's own work

Table 2.
Comparison of
student and staff and
faculty sustainability
background and
knowledge

Staff and faculty. For the staff and faculty survey, 283 of 1,286 individuals whom the survey was administered to responded (22.0%). Of these, 27.6% identified as male, and 71.0% identified as female. Employees associated with CMU for more than 10 years comprised 52.7% of the participants with 47.4% employed for less than 10 years. Academically, the least responses came from the College of Arts and Media, the College of Business and the College of Education and Human Services, comprising 3.6%, 6.5% and 8.3% of respondents, respectively. The most responses came from the College of Science and Engineering, the College of Liberal

Table 3.
Assessment of
sustainability
knowledge and
practice among
academic colleges

Question^	Arts and media <i>n</i> = 54	Business <i>n</i> = 53	Education and human services <i>n</i> = 66	Health professions <i>n</i> = 84	Liberal arts and social science <i>n</i> = 91	Science and engineering <i>n</i> = 113
Prior to taking this survey, have you heard of the term, "sustainability"?***	53 (98.1)	52 (98.1)	63 (95.5)	84 (100.0)	91 (100.0)	111 (98.2)
Do you think your individual actions can make a difference toward sustainability issues?	43 (79.6)	40 (75.5)	51 (77.3)	69 (82.1)	70 (76.9)	93 (82.3)
Did you recycle prior to your employment/attendance at CMU?*	45 (83.3)	39 (73.6)	56 (84.8)	65 (77.4)	72 (79.1)	103 (91.2)
Do you recycle currently?*	48 (88.9)	35 (66.0)	47 (71.2)	69 (82.1)	72 (80.0)	92 (81.4)
Do you feel informed about what can and cannot be recycled at CMU?	34 (63.0)	35 (66.0)	42 (63.6)	61 (72.6)	56 (62.2)	69 (61.1)
Do you actively compost?	5 (9.3)	9 (17.0)	12 (18.5)	11 (13.1)	20 (22.0)	23 (20.4)
Do you feel informed about what can and cannot be composted at CMU?	9 (16.7)	11 (20.8)	12 (18.2)	20 (23.8)	13 (14.3)	31 (27.4)
Do you actively try to minimize your food waste?*	36 (66.7)	39 (73.6)	41 (62.1)	57 (67.9)	71 (78.0)	95 (84.1)
Do you actively try to minimize your energy and water usage?*	40 (74.1)	35 (66.0)	38 (57.6)	61 (73.5)	70 (76.9)	89 (78.8)
Do you actively try to minimize your solid waste?	37 (68.5)	35 (66.0)	41 (62.1)	56 (66.7)	66 (72.5)	80 (70.8)
Have you seen recycling bins in campus buildings?*	50 (96.2)	48 (98.0)	64 (97.0)	80 (98.8)	88 (98.9)	110 (99.1)
Are you aware that CMU campus dining has a composting program?	17 (32.7)	15 (30.6)	26 (39.4)	29 (35.8)	31 (34.8)	53 (47.7)
Have you seen water bottle refill stations in campus buildings?*	52 (100.0)	45 (91.8)	64 (97.0)	79 (97.5)	88 (98.9)	105 (94.6)
Did you know that CMU derives 25% of its energy from wind power?*	5 (9.6)	2 (4.1)	7 (10.6)	9 (11.3)	4 (4.5)	7 (6.3)
Did you know that CMU derives 75% of its energy from coal?*	6 (11.5)	4 (8.2)	5 (7.6)	7 (8.6)	10 (11.2)	8 (7.2)
Did you know that CMU prevents approximately 40% of fits solid waste from being sent to landfills?*	4 (7.7)	7 (14.3)	2 (3.0)	9 (11.1)	7 (7.9)	8 (7.2)
Did you know that CMU is a member of the Association for the Advancement of Sustainability in Higher Education?	9 (17.3)	6 (12.2)	12 (18.2)	17 (21.3)	22 (24.7)	28 (25.2)

Notes: *Indicates significance at or below $p = 0.05$; **indicates questions that could not be tested for significance due to low response counts; ^Data represents positive "yes" responses
Source: Author's own work

Table 4.
Comparisons of
sustainability
engagement between
students and staff
and faculty

Multiple response question	Choices	Student: <i>n</i> (%)	Staff and faculty: <i>n</i> (%)
CMU has several sustainability programs in place. Check all of the ones that you have heard of	Student Groups (Take Back the Tap, Sierra Club, Student Environmental Alliance)	184 (45.3)	148 (51.7)
	Residence hall positions (sustainability director, sustainability advocates)	77 (19.0)	35 (12.2)
	Student government association sustainability committee	61 (15.0)	39 (13.6)
	Central sustainability	90 (22.2)	53 (18.5)
To what extent are you willing to support sustainability at CMU?	Volunteer for the recycling center	118 (29.1)	34 (11.9)
	Pay an annual sustainability fee (less than \$10)	116 (28.6)	80 (28.0)
What sustainability projects would you like to see pursued at CMU?	More sustainability volunteer opportunities	139 (34.2)	62 (21.7)
	More sustainability service-learning activities	124 (30.5)	91 (31.8)
	More sustainability guest speakers	79 (19.5)	41 (14.3)
	Composting bins in residential kitchenettes	174 (42.9)	127 (44.4)
	A designated recycling drop-off location for off-campus students, free of charge	235 (57.9)	188 (65.7)
	Increase energy acquisition from renewable sources	164 (40.4)	140 (49.0)
	Establish a formal sustainability office to oversee sustainability programs, projects and opportunities	125 (30.8)	51 (17.8)

Source: Author's own work

Arts and Social Sciences and the College of Health Professions, comprising 10.8%, 11.9% and 13.3% of respondents, respectively. Additionally, staff from nonacademic divisions comprised a large portion of staff and faculty responses, encompassing facilities and operations, communications and administration and student services, at 10.4%, 12.6% and 18.3%, respectively (Table 1).

Combined. Cumulatively, the survey garnered 675 responses (18.6% response rate). Total respondents were primarily female (69.3%). The College of Arts and Media, College of Business and College of Education and Human Services had the least responses, comprising 8.2%, 9.0% and 13.4% of responses, respectively. In contrast, the College of Liberal Arts and Social Sciences, College of Health Professions and College of Science and Engineering had the most responses, comprising 14.6%, 15.9% and 16.6% of responses, respectively (Table 1).

Comparison of student and staff/faculty sustainability background and knowledge

For 15 of the 17 yes/no survey questions, staff and faculty results yielded higher “yes” percentages, indicating more sustainability knowledge, awareness or behavior. Of these, ten yielded significant differences. Notably, when asked, “Do you think your individual actions can make a difference toward sustainability issues?”, students responded “yes” 77.4% of the time, whereas staff and faculty responded “yes” 90.5% of the time ($p < 0.001$) (Table 2). Similarly, regarding behaviors, when asked “Do you actively try to minimize your food waste?”; “Do you actively try to minimize your energy and water usage?”; and “Do you actively try to minimize your solid waste?”, students responded “yes” 70.4%, 68.1% and 63.3% of the time, respectively, whereas staff and faculty responded “yes” 83.3%, 88.0%

and 86.2% of the time, respectively ($p < 0.001$, $p < 0.001$, $p < 0.001$). All of these demonstrated significance favoring positive staff and faculty behaviors. When assessing recycling and composting knowledge and practice, similar trends were identified, as staff and faculty results yielded significance in comparison to student results when asked “Do you recycle currently?”; “Do you feel informed about what can and cannot be recycled at CMU?”; and “Do you actively compost?” ($p < 0.001$, $p < 0.001$, $p < 0.001$, respectively) (Table 2).

Regarding CMU-specific actions and policies, staff and faculty almost exclusively were found to have more pro-sustainability knowledge and behaviors than students. When asked, “Did you know that CMU derives 75% of its energy from coal?”, only 6.7% of student responses indicated “yes,” whereas 12.7% of staff and faculty responses indicated “yes” ($p = 0.01$). Similarly, when asked “Did you know that CMU prevents approximately 40% of its solids waste from being sent to landfills?”, 6.7% of student respondents indicated “yes” whereas 18.4% of staff and faculty respondents indicated “yes” ($p < 0.001$). Finally, when asked “Did you know that CMU is a member of the Association for the Advancement of Sustainability in Higher Education?”, 19.0% of student respondents answered “yes,” compared to 27.7% of staff and faculty who answered “yes” ($p = 0.011$).

Assessment of sustainability knowledge and practice among academic colleges

Of the 17 survey questions assessing sustainability background and knowledge, 4 questions yielded significance using a chi-squared test (Table 3). When asked “Did you recycle prior to your employment/attendance at CMU?”, individuals enrolled or employed in science and engineering, education and human services and arts and media responded “yes” at rates of 91.2%, 84.4% and 83.3%, respectively, in contrast to lower rates from liberal arts and social sciences, health professions and business, with “yes” rates of 79.1%, 77.4% and 73.6%, respectively ($p = 0.046$). In contrast, when asked, “Do you recycle currently?”, responses within academic colleges exhibited substantial variation. From highest to lowest, colleges were ordered arts and media, health professions, science and engineering, liberal arts and social sciences, education and human services and business, with “yes” rates of 88.9%, 82.1%, 81.4%, 80.0%, 71.2% and 66.0%, respectively ($p = 0.037$).

The remaining two questions with significant responses were associated with resource minimization behavior. When asked, “Do you actively try to minimize your food waste?”, academic colleges responded, from highest to lowest, science and engineering, liberal arts and social sciences, business, health professions, arts and media and education and human services, with “yes” response rates of 84.1%, 78.0%, 73.6%, 67.9%, 66.7% and 62.1%, respectively ($p = 0.013$). Similarly, when asked, “Do you actively try to minimize your energy and water usage?”, academic colleges responded, from highest to lowest, science and engineering, liberal arts and social sciences, arts and media, health professions, business and education and human services, with response rates of 78.8%, 76.9%, 74.1%, 73.5%, 66.0% and 57.6%, respectively ($p = 0.04$).

Multiple response and survey engagement

The final section of the survey included three multiple-response questions and one optional written response question gauging awareness and actionable items around sustainability at CMU. First, respondents were asked to indicate all of the institutional sustainability programs that they had heard of. Unsurprisingly, an overwhelmingly large portion of respondents indicated that they had heard of student organizations/clubs related to sustainability, with 45.3% of students being aware of these and 51.7% of staff and faculty being aware of these. The remaining three less-selected options were all directly tied to and

funded by CMU, with options being paid residence hall sustainability positions, the student government association sustainability committee and the new campus sustainability office.

The remaining questions asked respondents to indicate ways in which they would be willing to support sustainability initiatives at CMU. When asked about willingness to volunteer at the recycling center, 29.1% of students and 11.9% of staff and faculty members checked “yes.” When asked about willingness to pay an annual sustainability fee at or below \$10, 28.6% of students and 28.0% of staff and faculty members checked “yes.” When asked, “What sustainability projects would you like to see pursued at CMU?”, results indicated favorability toward waste and energy-oriented projects. Over 50% of both the student, and staff and faculty groups indicated that they would like to see a designated recycling drop-off location for off-campus community. Over 40% of both groups indicated that they would like to see composting bins in residential kitchenettes and an increase in university energy acquisition from renewable sources. These were very high results in comparison to projects and opportunities which required physical engagement, such as more sustainability volunteer opportunities, more sustainability service-learning opportunities and more sustainability guest speakers. Finally, when asked about the development of a formal sustainability office, 30.8% of student and 17.8% of staff and faculty checked “yes” (Table 4).

Discussion

Demographics

In the distribution of this survey, the student sample was comprised of exclusively undergraduate students. This 25% sample was a portion of the undergraduate student population taking classes on the CMU main-campus, and thus, graduate students were excluded from this study. This distribution methodology accounts for variation in sample size when compared to the reported student enrollment from the introduction (11,303 individuals enrolled the following fall), and must be taken into consideration when interpreting results.

Regarding survey responses, it was found that, for both groups, female respondents greatly outnumbered that of male responses, with nearly 70% of combined responses being female and approximately 30% male. The overall gender composition of the student body at CMU for the fall 2022 semester was reported as 60% female and 40% male (CMU Fall Enrollment History, 2023). Additionally, this data is reflective of the results of numerous other studies, notably a 2012 survey of Middle East Technological University which found that females are likely to hold more pro-sustainability attributes and engage in sustainability behaviors and thus engage more with sustainability materials such as this survey (Sahin *et al.*, 2012). That said, a 2023 study of 430 students at a Saudi Arabian university garnered nearly equal male and female respondent rates, although it lacked equal representation among under- and upper-classmen (Al-Zohbi and Pilotti, 2023).

In this research, as anticipated, more students from STEM fields engaged with the study, with the College of Science and Engineering and College of Health Professions garnering the most responses. This is likely because of their familiarity with terms such as “environment,” or “sustainability” from relevant coursework, or perhaps due to a natural inclination toward these topics as individuals studying STEM fields. That said, it was not anticipated that the College of Liberal Arts and Social Sciences would produce near equal numbers of responses, thus indicating that sustainability is potentially a topic of interest across the entire higher education environment, and not necessarily specific to one or a few fields of study. Sustainability is multidisciplinary in nature and thus must be approached from all disciplines within higher education (Sibel, 2009).

As this is believed to be the first survey assessing staff and faculty sustainability knowledge and behavior in the higher education environment, there are few datapoints to compare within other studies. Despite this, response proportions nearly mirrored student responses, with the most respondents coming from the College of Science and Engineering, College of Liberal Arts and Social Sciences and College of Health Professions. Additionally, nearly half of staff and faculty respondents have worked at the institution for less than 10 years, and half for more than 10 years, indicating that longevity of employment at an institution is unlikely to sway engagement with sustainability materials like this survey.

Comparison of student and staff/faculty sustainability background and knowledge

When comparing the student to the staff and faculty results, it was found that a majority of the time, staff and faculty demonstrated more pro-sustainability knowledge and behavior than students. It was found in 15 of the 17 questions in this section that students lack in sustainability knowledge when compared to staff and faculty, and ten of those with significant results. These findings resemble prior studies, indicating that students generally have low knowledge regarding sustainability concepts and institutional sustainability initiatives (excluding faculty comparisons). A 2007 study found that students lack a holistic understanding of the term “sustainability,” indicating a willingness to sacrifice social and economic interpretations in exchange for environment (Kagawa, 2007). Other studies demonstrated that students are largely unaware of campus sustainability initiatives and lack knowledge about sustainability, despite recognizing its importance (Msengi *et al.*, 2019; Alsaati *et al.*, 2020). Similarly, a 2014 sustainability study of engineering students indicated that respondents lacked knowledge on questions related to current sustainability events and technological innovations (Sharma *et al.*, 2014). To date, research specific to student sustainability knowledge has indicated that students generally lack sustainability knowledge and understanding. Overall, the existing body of research and this research demonstrates that students are unprepared to address sustainability issues within their respective career fields, especially in comparison to their educators. Potential solutions to address this at CMU may include adding mandatory general education requirements around sustainability, integrating sustainability in the orientation and residence life experience and working as a university to create and uphold commitments around waste reduction, renewable energy, clean water, climate change and sustainable food and transportation systems.

While there were no identified prior research papers comparing student, staff and faculty sustainability knowledge at higher education institutions, it is believed that trends in which staff and faculty have more sustainability knowledge are a product of longer terms of employment experienced by staff and faculty, in comparison to the temporary enrollment status of students (Table 2). A 2020 eight-year study at Indiana State University found that freshmen have gradually demonstrated more concern for the environment each year, and they have shown increased concern for the environment over their collegiate careers (Speer *et al.*, 2020). These findings, when paired with the results of this research, may indicate that longevity at an institution, whether through enrollment or employment, increases the likelihood of garnering interest, knowledge and action around sustainability. That said, the process through which an individual acclimates to and learns about sustainability concepts could be expedited through more focus on sustainability issues and topics throughout the university, including all academic and non-academic departments and divisions.

Assessment of sustainability knowledge and practice among academic colleges

For nearly every question, it was found that students, staff and faculty the College of Science and Engineering, College of Health Professions and College of Liberal Arts and Social Sciences results indicated more pro-sustainability knowledge and behaviors, in comparison to peers in the College of Arts and Media, College of Business and College of Education and Human Services. First, regarding recycling behavior prior to and during enrollment and employment, the order ranking of college participation in recycling prior to and during an individual's time at CMU changed vastly, with the only exceptions being the College of Liberal Arts and Social Sciences ranking fourth for both questions and the College of Business ranking last. Notably, the College of Health Professions ranked fifth for prior recycling behavior, but second for current recycling behavior, indicating that some factor within the health professions field or physical environment at CMU has a positive effect on increasing recycling behavior (Table 3). This could be attributed to increased visibility of signage, more building and lab space or faculty and course content within environmentally oriented health curricula such as those under a "Public and Environmental Health" program. Additionally, improvements such as this one could be a direct product of recent university-specific initiatives to improve recycling rates and behavior by Central Sustainability and CMU Facilities Management. These include newer programs to recycle electronics, pizza boxes, candy wrappers and food waste on campus. Many of these opportunities are not offered to students in their hometowns prior to their attendance at CMU, and therefore, current recycling behavior is more likely to increase as a product of expanded access to these waste reduction opportunities (Derksen and Gartrell, 1993). Additionally, programs such as health professions courses are largely housed in one building and thus signage and physical changes have direct influences on the students within these programs.

Unlike recycling behavior questions, resource conservation questions yielded similar results when comparing academic colleges, with the College of Science and Engineering responding the most positively to food waste, and energy and water conservation questions and the College of Education and Human Services responding the most negatively to both questions (Table 3). While difficult to attribute to academic coursework, this could be because all students at CMU live on-campus for at minimum one year and thus are exposed to the same living-situations, including energy and water infrastructure. In contrast, varying building and living communities have varying levels of accessibility to and enthusiasm around recycling, thus explaining some variation in recycling behavior. At CMU, recycling is emphasized in programs and education far more than resource conservation, and therefore, few things in the educational environment are currently influencing behavior around resource conservation.

As a university, CMU ranks higher than most other higher education institutions in waste diversion, but often lags in other facets of sustainability. Regarding waste, the 12-month diversion rate for CMU was 46% as of December 2022, which is 25% higher than the Michigan average diversion rate of 19.3%, and 14% higher than the United States diversion rate of 32.1% (Johnston, 2022; EPA, 2022). Despite this, CMU only held a "Silver" rating from AASHE up until 2021, when the establishment of the student led sustainability office, Central Sustainability, bolstered the university ranking to "Gold" (AASHE, 2022). Yet, this deficit is not the responsibility of one sole campus unit, and thus, it is important to gauge which academic units contribute to growing knowledge, and thus action, around sustainability and university development. However, if the College of Arts and Media, College of Business and College of Education and Human Services consistently lack in sustainability knowledge and behavior for student, and staff and faculty groups, then

targeted education and programming for these communities must be used to engage individuals around sustainability.

Multiple response and survey engagement

Within the final section of the survey, multiple response questions enabled respondents to indicate familiarity with sustainability programs and initiatives, willingness to get involved in sustainability efforts and what sustainability projects they hope to see pursued at CMU. Surprisingly, there was less awareness of programs started by the university, suggesting that student-driven initiatives are more likely to raise awareness among students, staff and faculty (Table 4). For instance, students, staff and faculty had high awareness of student environmental clubs, whereas they generally lacked awareness of sustainability positions in the Student Government Association and Residence Life. That said, these university-funded sustainability programs are relatively newer than sustainability-oriented student groups, and therefore, respondents are more likely to have had exposure to the student groups having more longevity.

For action-oriented questions, it was found that there was substantial variation within staff and faculty responses, but more consistency within student responses. This variation could be attributed to students often being at the institution for a typical maximum of four years, whereas staff and faculty longevity exceeded ten years in approximately half of responses. Therefore, staff and faculty see the institution through a unique lens, and thus are willing to support sustainability in different ways than students.

Finally, when asked what sustainability projects respondents would like to see pursued, the most popular responses often involved waste- and energy-oriented solutions. Although CMU is a leader in composting and recycling, these waste disposal options are not necessarily accessible to all facets of the university, such as residential hall kitchenettes, office spaces and certain public cafeterias. Additionally, respondents, while unaware of ongoing energy initiatives such as purchasing from renewable wind sources, expressed a desire for the institution to increase investment and involvement in sustainable energy projects. Therefore, in cases like this on in which the programs desired may already exist, results speak to a lack of marketing and education around present energy (and other) programs. CMU can easily improve these education deficits through using the infrastructure in place as an educational tool.

Most notably, while the recent and ongoing establishment of a university sustainability office (Central Sustainability) has garnered major success and accomplishments, it has also demonstrated that the campus community, especially students, are lacking in sustainability knowledge, thus creating a barrier to pro-sustainability action. Overtime, attempts at addressing this gap have yielded varying levels of success, such as the establishment of a residential composting program, engagement of students in community gardening and providing sustainability volunteer opportunities to students. Therefore, despite lower “yes” responses to the need to bolster the institutional sustainability office, positive responses to the programming and education produced by this office suggest that it needs time to grow and affect the entire campus community.

Student input

The final question of the survey prompted respondents to provide input by asking, “Do you have any comments on sustainability at CMU that you would like to share?” Impressively, approximately half of the responses indicated strong favor for the installation of a recycling drop-off location for off-campus students. Just a few sample responses related to this included:

- “I would even pay something cheap to have recycling for off-campus students, seriously pursue that it seems easier to do first.”
- “PLEASE create a recycling drop-off for off-campus students! We have been throwing so many things away because we have nowhere to take them to recycle them.”
- “off campus apartments do not have recycling bins!! so it is hard to recycle here.”
- “Off campus apartments do not allow for recycling in a reasonable way, if there was a way to help with that?”
- “Living off campus/near campus is really hard to recycle because they don’t provide bins or info about where to go. As a full time student, I have a limited ability to go somewhere else to drop off recycling.”
- “As an off campus student, I think it would be beneficial to have a place to go to once a week to recycle.”

Aside from responses oriented toward waste reduction, a notable amount of students indicated a desire to see larger investment in renewable energy systems and greater accessibility and education for and around existing and new sustainability structures, such as LEED certified buildings, composting systems and residential hall recycling opportunities. These are all possible within the context of CMU and similar institutions but require consistent investment and attention from university leadership to achieve success. In the case of CMU, resources directed toward institutional sustainability opportunities such as Central Sustainability, student government and residence life sustainability positions and student sustainability groups will enable students, staff and faculty members to become changemakers around institutional sustainability challenges.

Limitations

It is worth noting that there are several limitations to this study to take into consideration when assessing results. First, while potentially indicative of interest in sustainability topics, responding to the study survey was optional, and thus, there was no way to guarantee equal representation across academic or student groups. That said, as reported in the demographics section, responses for gender mirrored that of other studies, while responses from varying academic colleges resembled the proportions of students enrolled in these university facets to begin with. Additionally, the survey does not differentiate between staff responses and faculty responses. This may lead to unintended influence from staff individuals who are not directly tied to academics, such as support staff who work in specific academic divisions but do not engage with related academic content. Finally, while ideally representative of all academic higher education institutions, this survey only assessed students, staff and faculty at CMU, and therefore may only have major implications for peer institutions, Carnegie R^2 institutions or schools similar in size and demographic, while not as significant implications for significantly smaller or larger schools or those significantly different in demographic composition. With this in mind, readers must also consider that these results are not fully representative of the entire student, staff and faculty body at CMU due to selection bias and non-response bias (Qualtrics, 2023). Therefore, the statistical analysis performed are only true for the respondent population and thus are not necessarily translatable to other institutions unless deemed applicable.

Conclusions and next steps

Overall, it is abundantly clear that sustainability needs to be further addressed and implemented within the CMU community. The collective results of this survey indicate that students, staff and faculty care about waste, water, energy and food issues as they pertain to sustainability and hope to see them addressed at an institutional level. Yet, as indicated by these results, students in particular, like those in similar studies, lack in sustainability knowledge and associated actions, despite caring about them (which differs from staff and faculty knowledge). Therefore, sustainability must be addressed through multifaceted approaches that integrate academics, administration, operations and student services to best prepare students for a changing world (Sibel, 2009).

Moving forward, future research and projects will build on the present study through further investigating why specific academic colleges or units positively or negatively influence sustainability knowledge and behavior, as this could be a product of curriculum, or physical environment and programming. Additionally, knowing that staff and faculty have more pro-sustainability knowledge and behaviors, it will be vital to gauge why this has not often translated to the students they are educating. Perhaps this is an indication that personal values and individual background has a stronger influence on sustainability knowledge and behavior than external influences, although this must be further investigated. Regardless, it is clear that support exists for the implementation of sustainability projects and programming within higher education institutions such as CMU, and therefore, action must be taken to meet the demands of the CMU community.

Other similar studies have engaged students through knowledge- and action-based assessments of sustainability culture in higher education environments. For instance, a 2012 study at Middle East Technical University found that gender and media usage were the best predictors of sustainability values and attitudes (Sahin *et al.*, 2012). In contrast, a 2023 study at a Saudi Arabian University found that while students care about sustainability, values may not be a predictor of behavior, and thus the status-quo around sustainability education must be challenged (Al-Zohbi and Pilotti, 2023). Therefore, it is clear that numerous mechanisms, activities and communication channels must be used to continually and uniquely engage students, staff and faculty around sustainability. At CMU, this may mean administrative sustainability planning and commitments which can then be carried out through institutional mechanisms such as Central Sustainability, student government and residence life sustainability positions and sustainability student groups.

Within higher education institutions, numerous barriers to sustainable development persist, despite resounding community voices pressing for investment and involvement in sustainability projects and engagement. Most notably, economic barriers and frugal decision-making leads to hesitancy to invest in sustainability projects with long-term return potential. Additionally, resistance to change and institutional fragmentation are found to present both individual and institutional challenges to addressing sustainability (Gale, 2015). At CMU, these factors coupled with competing areas of growth are believed to lead to the stagnation of sustainable development, despite community interest. That said, investment in sustainable strategies can often yield financial and social profits, such as through the lower cost of compost hauling in comparison to landfill hauling or through the community building and sense of happiness produced through green spaces. In fact, according to a 2018 CMU Sustainability report produced by the Great Lakes Institute for Sustainable Systems, CMU saved over \$10,000,000 from investment in sustainability infrastructure and processes in Facilities Management between 2008 and 2017 (Rohrer *et al.*, 2018).

Regarding physical projects and programming, this survey will ideally result in more emphasis on institutional projects and commitment related to waste and energy – mainly through the betterment of existing recycling and composting systems. Additionally, the information provided by this study will ideally be used to inform targeted approaches to sustainability education within specific academic colleges at and beyond CMU, especially because each institution and department within has its own unique sustainability achievements and challenges. Again, this is a testament to the multifaceted yet interdisciplinary nature of sustainability, thus necessitating unique and innovative approaches to sustainability challenges and education within higher education institutions.

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