

Residential Composting Behavior

A Study of Waste Practices Among U-M Students Living in South Quad Residential Hall

Arynne Wegryn-Jones

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Introduction

STOP!

All paper plates, paper bowls,
napkins, paper cups,
plasticware, syrup cups, are
COMPOSTABLE

Please bring them to dishroom
so that they can be properly
disposed of.



Pictured above is a sign I designed and posted near every trash can in the dining hall within South Quad residential hall in the spring of 2019. Nearly all University of Michigan Dining (MDining) products in both dining halls and retail locations are 100% compostable. Napkins, tea bags, all food scraps, and even the chopsticks provided in the dining halls can be composted. Each year the University of Michigan (U-M) spends thousands of dollars more on compostable dining materials and composting services than they would if they did not offer composting (1). However, during my time as an employee at the dining hall within South Quad, I had seen countless plastic garbage bags full of these materials go to the landfill. Many customers still fail to properly identify where to put their waste – an issue that presents a grand cost to U-M and to the environment.

In 2011, the University of Michigan developed 6 sustainability goals to achieve by 2025. One of these goals was to reduce the amount of waste sent to landfills by 40 percent over baseline (2006) levels. In 2020, U-M was at 17% waste reduction, even in spite of a 31% increase in campus population since the baseline year. A large part of this waste reduction effort included integrating composting into the U-M waste system. In a landfill, food waste decomposes anaerobically, producing methane, a greenhouse gas (GHG) that is 23 times more potent than carbon dioxide in its heat-trapping potential. Composting allows the university to reduce GHG emissions from landfills and increase student awareness of participation in sustainability (2).

In the fall of 2019, compost bins were rolled out in every hall closet, on every floor, in every residential hall on campus. Students living in residence halls suddenly had the option to take care of food scraps and other compostable materials in bins conveniently located right next

to where they put their landfill waste and recycling. The residential composting program was a big step in reducing the amount of waste U-M sends to landfills. However, the program's success continues to depend on the educational resources available to the students who are using them. U-M's compost vendor, WeCare Organics, requires that at least 99 percent of waste delivered is compostable (3). Even a small amount of non-compostable material going into a compost bin can render the whole bag unusable, and contamination also drives up the costs of processing that waste.

This thesis intends to address how, if at all, the expansion of the U-M composting program into residence halls affected the knowledge and action around composting among students. The research focuses on South Quad Residence Hall, due to the large sample size of student residents (about 1,170) and because the majority of South Quad residents are freshmen and likely have more limited knowledge of the University's composting efforts prior to the start of the project.

Four broad questions guide this research: 1. Are students aware of the bins down the hall? 2. Are students using the bins? 3. Are students using the bins correctly? 4. What experiences and external factors might contribute to these students' knowledge about composting? In three consecutive semesters (Fall 2019, Winter 2020, and Fall 2020), surveys were sent out to students living in South Quad to assess their knowledge and awareness of composting. Using the survey findings and research on compost education practices at other universities, recommendations were developed for U-M's compost program to help reach the 2025 goal.

Three hypotheses were developed to guide this work:

H1: Having previous knowledge about composting (i.e. before coming to U-M) will be correlated with higher awareness and action around composting.

H2: Current involvement in sustainability on campus, such as being enrolled in a class with a sustainability focus or being involved with an environmental student organization on campus, will be correlated with higher awareness and action around composting.

H3: Later surveys will show greater compost awareness among students living in South Quad.

Methods

Three surveys were conducted in total, all through Qualtrics software. All three surveys were promoted exclusively via email to South Quad residents, and a follow-up email was sent two weeks after the initial email for each survey. Survey 1 was released in September 2019 and received 359 responses. Survey 2 was released in April 2020 and received 66 responses. Survey 3 was released in September 2019 and received 196 responses (**Figure 1**). All three surveys qualified for IRB exemption for research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or

observation of public behavior (including visual or auditory recording) if the information obtained is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained, directly or through identifiers linked to the subjects. The statistical significance of response comparisons was determined using the Crosstabs feature on Qualtrics using a 95% confidence interval. Demographic data includes a section labeled “Two or more” for the percentage of respondents that selected two or more groups as their ethnic/racial identity, as well as a section labeled “Unknown” for those who did not select any of the listed ethnic/racial identities.

Results

Survey 1 found that 40% of students were aware of the locations of the compost bins in their residence halls, and 35% of students had used them. Survey 2 saw these numbers double (80% were aware of the bins and almost as many had used them), and Survey 3 showed about 75% awareness and usage (**Figures 2 and 3**).

All three surveys showed a trend of students who hadn’t composted in the past year being less likely to know about or have used the compost bins than students who said they had composted in the past year. The vast majority of respondents to Surveys 1 and 3 were freshmen, and for these respondents the “past year” was the year prior to coming to U-M. The upperclassmen that responded were more likely to self-report knowing a fair amount about composting at U-M than freshmen.

The surveys asked about what students did with compostable dining materials after they ate a meal. For Surveys 1 and 2, the only opportunity that students had to eat off of compostable ware was when they ate a meal from the Kosher station inside of South Quad. Most of the food in all dining halls is served on dishes that are later washed in a dishroom. Kosher laws call for a special cleaning process with these items, so South Quad chose to offer disposable items instead of reusable dishes. In Surveys 1 and 2, I first asked whether students had eaten a meal from Kosher, and if they said yes, I asked them what they did with their plates/bowls, their utensils, and their napkins, in three separate questions. The response options were “took them to the dish room”, “threw them in a trash can”, or “threw them in a compost bin”.

Survey 3 was released in Fall of 2020, when dining halls were only doing to-go options and eating off of compostable items from Kosher wasn’t an option. The question was switched from “have you eaten a meal at Kosher” to “have you eaten a meal from South Quad?” and the option for plates/bowls was changed to “to-go containers”. Additionally, bringing the items to the dish room wasn’t an option for Survey 3, since the dining halls were closed for dine-in, so Survey 3 respondents either chose “threw in a trash can” or “threw in a compost bin”. The results showed a large jump in the percentage of respondents who were composting their plates/bowls/to-go containers and napkins between surveys 1 and 2, which stayed relatively steady for survey 3. For utensils, there was a slightly lower amount of students composting their

utensils in all three surveys than they did with their plates/bowls/to-go containers (**Figures 4, 5 and 6**).

Respondents were asked to indicate whether certain items were compostable. The question showed labeled images of commonly used items found in South Quad dining hall, and asked the respondent to select the items that they thought were compostable. The napkins, utensils, and to-go containers listed were all specified as being those from South Quad dining hall, to serve as a hint that they should be compostable. All surveys found that a majority of respondents were able to identify apple cores, orange peels, and napkins as compostable. However, respondents in Surveys 1 and 2 incorrectly identified sweetener packets as compostable 11% and 8% of the time, respectively. The percentage of respondents correctly identifying utensils as compostable largely increased across the three surveys, with 34% saying that utensils were compostable in Survey 1, 53% in Survey 2, and 82% in Survey 3 (**Figure 7**). This was by far the most dramatic increase in compost knowledge shown by this question.

Students who reported having composted in the past year were more likely to have used a compost bin in their residence hall. Only Surveys 1 and 3 are focused on for this question, because Survey 2 took place during the winter semester, and the question about having composted in the past year includes some of the respondents' time at U-M, which was not intended to be captured in the data. In Survey 1, less than a quarter of students who reported never having composted in the past year said they had used a compost bin in their hall, compared to over half of the students who said they had always composted or composted most of the time in the past year (**Figure 8**). For survey 3, an option was added for students who were not sure if they had used a compost bin, but the results still show the same trend as the first survey. More of the students who reported composting in the past year had used a compost bin in their residence hall than those who didn't (**Figure 9**).

Respondents to Survey 3 who self-reported being in a sustainability-focused class or student organization (club) tended to know more about composting at U-M than students who were not a part of a sustainability-focused class or club (**Figures 10 and 11**). Surveys 1 and 2 found no significant differences in compost awareness between respondents who self-reported being involved in a sustainability class or club and those who were not.

Survey 2 was distributed near the end of the winter semester, so an additional question that was added asked respondents about their living situation for next year and the likelihood that they would compost after moving out of South Quad. 83% of respondents said that they planned to live off-campus the following year, and of those, only 7% said they knew whether or not composting services would be provided where they would be moving. Significantly more students living on-campus the following year said that they plan to compost than students living off-campus. Nobody who planned to live on-campus the following year said they would never or rarely compost (**Figure 12**).

A question added to Survey 3 that wasn't on Surveys 1 or 2 asked where students ate their meals after getting them to-go from South Quad dining hall, as to-go meals were the only option during the semester that this survey took place. 66% of respondents said that they tended to eat most of their meals in their dorm room, 34% ate their meals outdoors near their dorm building, and no one reported that they ate in indoor common areas. It's worth noting that this survey ran early in the fall semester (Sept-Oct 2020), so these answers likely don't reflect student behavior after the weather got colder and eating outside became less popular.

Another question that was unique to Survey 3 asked what students did with the paper bags that the dining hall distributed with each meal. The survey found that paper bags were most often recycled or thrown in a trash bin, and about 20% were composted. 23% of respondents said they didn't use the paper bags that were handed out at the dining halls, either because they brought their own bags or simply didn't use a bag (**Figure 13**).

Discussion

All three hypotheses were supported by the data. The surveys found an increased awareness and usage of the compost bins in South Quad, increased rates of composting, and increased knowledge about what is compostable over time (H3). Higher awareness around composting was more prominent among respondents that reported having composted in the past year (H1) and those that self-reported being involved in a class or student organization with a sustainability focus (H2). The increase in knowledge over time could be due to students responding to Survey 2 having more time to notice the compost bins over the course of the academic year than those who responded to Survey 1. For Survey 3 respondents, it is possible that Resident Assistants (RAs) and other students who returned to South Quad after living there the previous year had more knowledge about the compost bins to share with their peers.

A limitation to this research was that Survey 2 only had a 5.6% response rate, compared to 31% and 39% response rates for Surveys 1 and 3. Additionally, only 48% of the respondents to Survey 2 self-reported being freshman, compared to 99% and 96% in Surveys 1 and 3. Survey 2 was released in April 2020, after the University transitioned to a virtual format due to the COVID-19 pandemic. By the time the survey got to students, a lot of them had either moved home or were dealing with the uncertainty of the times, which likely was a cause of the low response rate for Survey 2. It was found that respondents to Survey 2 who reported being upperclassmen were more likely to know about composting at U-M, so it is likely that the higher proportion of upperclassmen that responded to Survey 2 contributed to the large increase in compost awareness and action between Surveys 1 and 2. However, the similarly high rate of compost awareness and action in Survey 3 provides evidence that there was a general trend of increased knowledge across the three surveys, even if the data from Survey 2 was skewed by the demographics of the respondents.

Another limitation to the research was a lack of a waste audit as supporting data. I had originally planned to conduct a waste audit of South Quad in March 2020, but the COVID

shutdown caused the audit to be cancelled at the last minute. Audit data could have provided a concrete investigation into whether students were composting correctly by physically assessing contamination rates and top contaminants in the residence hall compost bins at the end of the semester.

The scalability of the survey findings are limited by the fact that my research only focused on one residence hall on campus, even though it was a larger residence hall. Future research should aim to assess compost practices in other residence halls, and should also examine off-campus compost behavior, since students living off-campus make up about 70% of the total student body.

The COVID-19 pandemic and subsequent switch of the dining halls to to-go options made compostable items and compost bins much more visible on campus. This increase in visibility could have had a positive influence on compost awareness on campus, partially explaining the positive trend I found in my data. Additionally, I did not ask about student perceptions of signage or messaging around compost education, which could've had an important influence on compost behavior. Since I did not directly measure the influence of COVID-19 or signage on compost behavior, future research could work to examine these relationships more closely and investigate whether increased compost visibility could have implications for compost knowledge among students.

Composting Best Practices

When U-M was working to expand the effectiveness of their composting program, they looked at like-minded institutions and found that solutions were not always readily available elsewhere (3). An exception to this was Northwestern University (NU), who ran an experiment to determine the effectiveness of a front-of-the-house (customer-oriented) composting program in a university setting (4). NU was already making efforts to procure more compostable foodware, but all of those compostable items were being discarded in landfill, much like what I was seeing in U-M dining halls.

The compost pilot program was launched in the largest food retail hub on NU's campus in the spring of 2019. The student-led study team designed a series of composting program experiments to minimize contamination. The composting program tracked composting volumes, contamination rates, and bin acceptance rates. NU recruited volunteers to supervise the compost bins for the first two weeks of the program. After the third week of the program, they introduced a lid to the compost bins.

The study team found that during the first two weeks of the program during which volunteers were stationed at the bins to help customers sort their waste, the compost acceptance rate was 100%, meaning that contamination of the bins was at a low enough level for the compost company to accept them. During the third week, during which there were no volunteers, they found that the volume of compost was reduced by half and the compost acceptance rate was

only 26%. At the start of the fourth week, the team introduced lids to the compost bins to make it more inconvenient for students to contaminate them. They found that although the volume of compost decreased slightly, the overall compost acceptance rate increased to 77%. These results are summarized in **Figure 14**. The study team was able to conclude that front-of-house composting was possible in a university setting, and that signage on its own does not effectively deter compost contamination. This finding is significant because signage is the main tool the University uses to encourage composting on campus, and if signage alone doesn't work, then we need to consider supplemental items that would work with the signage to promote proper composting behaviors.

At U-M, progress towards the 2025 sustainability goals started off rather slow. When Mark Schlissel became president of U-M in 2014, he saw that work needed to be done to figure out how these goals were going to be achieved by 2025. Schliessel pulled together working groups for each of the goals, drawing on faculty, staff, and students from various disciplines and departments to examine opportunities for sustainable action on campus.

Drawing from the waste working group's recommendations, the University developed a standard color scheme and design for each waste bin (black for landfill, blue for recycling, and brown for composting) and made the bins look identical everywhere on campus. They placed each of the types of bins into sets, literally attaching the bins to one another so they couldn't be separated. This helped because the working group found that when bins were separated, people tended to throw trash in the nearest bin, regardless of what type of bin it was. They developed consistent signage that included images of the items that could go in each bin, and commissioned line-drawn versions of each item from one artist to promote consistency of design. They removed bins from classrooms and other areas where they found the bins weren't getting filled. This reduced the number of half-full trash bags that were getting thrown out, and decreased the number of trash bags that were needed. They relocated bins to more centralized locations. They offered variations on the standard signage for places on campus where the waste stream was a little different from the rest of campus. Michigan Medicine and Michigan Dining both have slightly different versions of the "standard" signs based on the products that tend to get thrown out in those locations (**Figures 15, 16 and 17**). They also made supplemental signage available for units that have more specific needs. Lastly, they strategically placed the compost bins farthest from areas of high traffic, such as near an entrance or exit, or next to a condiment station, and placed lids on the compost bins. These design choices reflect the concept that at a very basic level, people tend to take the path of least resistance. Although they seem like small actions, lifting the lid on the compost bin or taking an extra step to reach another bin are additional inhibitors to contamination.

By providing standardized, image-heavy signage, placing lids on compost bins, and recruiting student volunteers to help educate students on proper waste disposal behaviors, the University of Michigan is following best practices for university composting. However, there is

still room for improvement to help the university achieve its goal of diverting 40% of landfill waste by 2025. I've developed three main recommendations as a result of my research:

1. The University should develop stricter purchasing policies to limit the variety, amount, and type of disposable items available to students, faculty and staff. By reducing the variety of items on campus, consistent and concise signage is easier to make. By reducing the amount of disposable items available and encouraging reusables where possible, the overall waste stream coming out of the University can be reduced.
2. Studies show that increased engagement increases the chances of behavior change. The university could work to feature notable students, athletes, or alumni on signage or within messaging to bring more attention to the issue. Interactive waste exhibits and demonstrations could serve as ways for students to actually visualize what needs to be done. And hosting community waste audits and publicizing the results could be another effective way to increase student engagement with the issue of waste.
3. The University should consider acquiring methods to more meticulously weigh the composting they collect, and conduct frequent audits to determine levels of contamination. These measurements would serve as benchmarks for improvement, and could also be marketed to students as evidence of the university's progress and to illustrate the role that students play in this progress. Current methods of waste auditing are very labor intensive and difficult to coordinate, and gathering volunteers or making room in the University budget to pay staff to conduct these audits are barriers to implementation. With improved technology and greater collaboration with WeCare Organics, it is possible that the University could develop reliable methods of waste auditing without intense labor requirements.

Conclusions

I am optimistic that the University can continue to improve their on-campus waste program to support less overall waste and more composting. Similar assessments of compost knowledge and behavior should be conducted on a larger scale and within other residence halls besides South Quad. These assessments should be accompanied by waste audits to track progress towards the 2025 waste reduction goals and identify areas for improvement. Additionally, future studies should work to address the state of off-campus composting, which is a significant contributor to the waste footprint of the University. The work does not end in 2025. Continuation of research on waste behavior and the improvement of waste reduction and education efforts are an essential part of reducing the University's environmental impact and working towards a more climate-conscious population at the University of Michigan and beyond.

Literature Cited

1. Morales, Laura. "Composting Fees Cost University Hundreds of Dollars per Week." *The Daily Texan*, 9 Oct. 2019.
2. Resource Recycling Systems. UM-Ann Arbor Compost Feasibility Study. Resource Recycling Systems, 22 Feb. 2011.
3. Fisher, Adam. "Dining to-Go Sites Opening with Extensive Composting Options." *The University Record*, 26 Aug. 2020.
4. Barton, Olivia, and Vivian Xu. "Composting at Northwestern University Norris Center." *AASHE*, 20 May 2019, hub.aashe.org/browse/casestudy/21868/Composting-at-Northwestern-University-Norris-Center.

Appendices

Survey Response Rates			
	Number of Invitations Sent	Number of Responses Received	Response Rate (%)
Survey 1 (F19)	1170	359	30.68%
Survey 2 (W20)	1170	66	5.64%
Survey 3 (F20)	500	196	39.20%

Figure 1. Survey response rates show a significantly lower response rate for Survey 2 than for the other surveys. Surveys 1 and 2 were sent to all South Quad residents, which is estimated to be 1,170 based on the South Quad Housing website. For Survey 3, invitations were only sent to a subset of 500 students living in South Quad due to altered University Housing processes for survey distribution. Source for South Quad resident number:

<https://housing.umich.edu/residence-hall/south-quadrangle/>

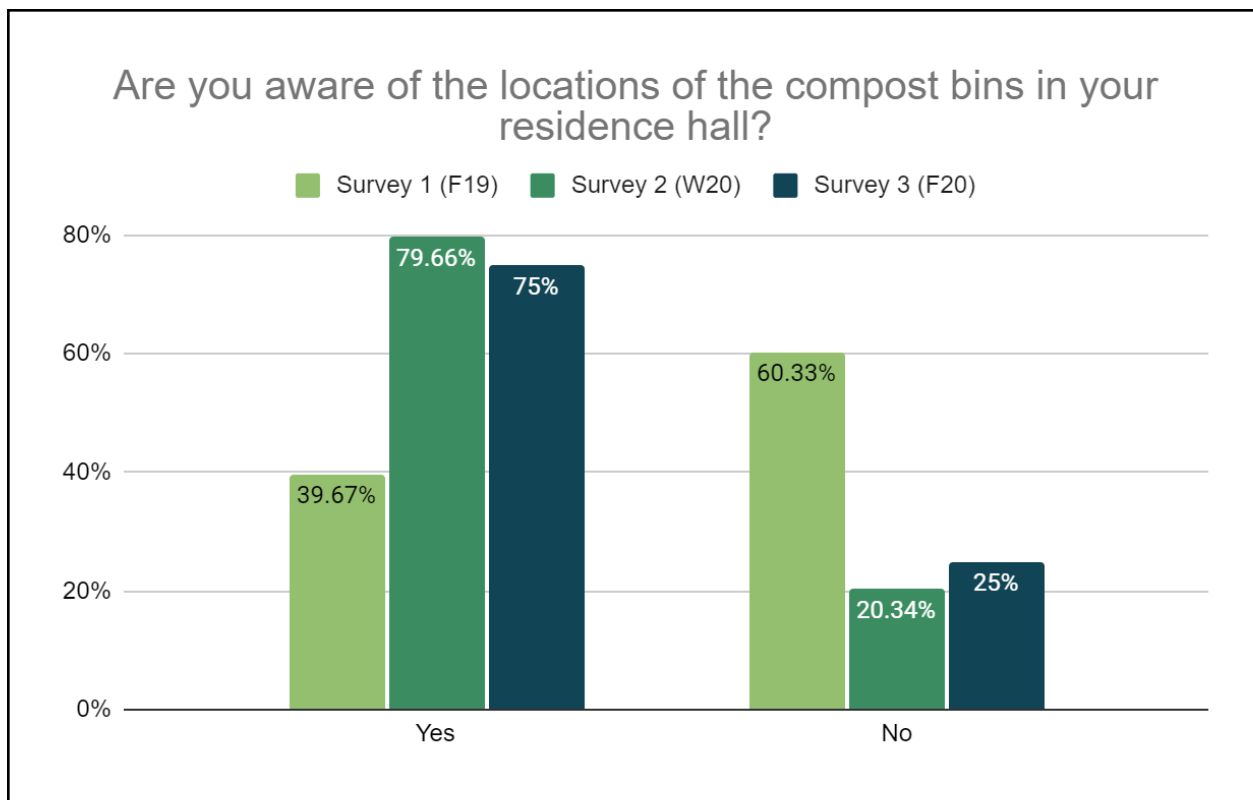


Figure 2. Respondents to Surveys 2 and 3 reported significantly higher awareness of the

locations of the compost bins in their residence hall than the respondents to Survey 1.

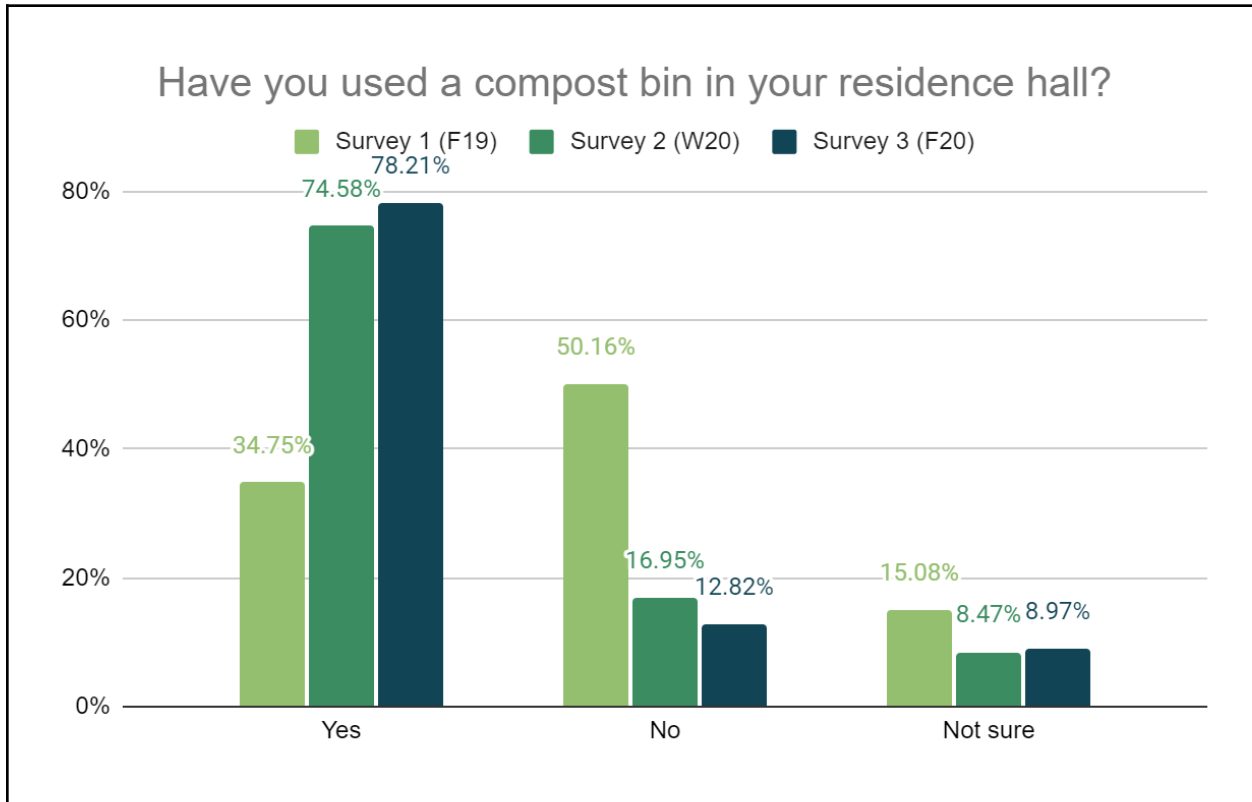


Figure 3. Respondents to Surveys 2 and 3 were significantly more likely to have used compost bins in their residence hall than the respondents to Survey 1.

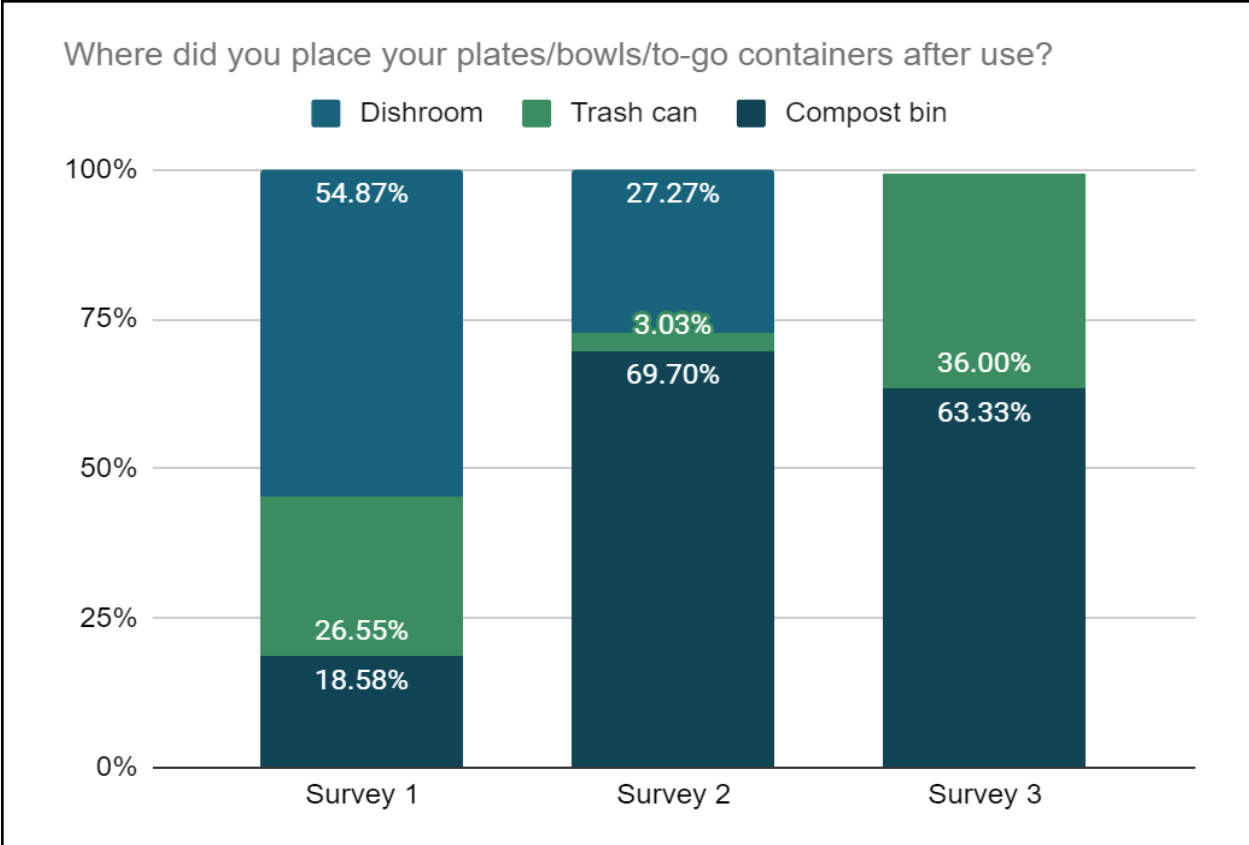


Figure 4. Analysis of students’ tendencies to dispose of the compostable plates, bowls, and to-go containers supplied by South Quad dining hall. There is a general increase in the number of students who disposed of plates, bowls, and to-go containers in compost bins rather than trash bins over time. “Took them to the dish room” wasn’t listed as an option for Survey 3 because at the time the survey was distributed, the dining hall was doing to-go service and taking things to the dish room wasn’t an option.

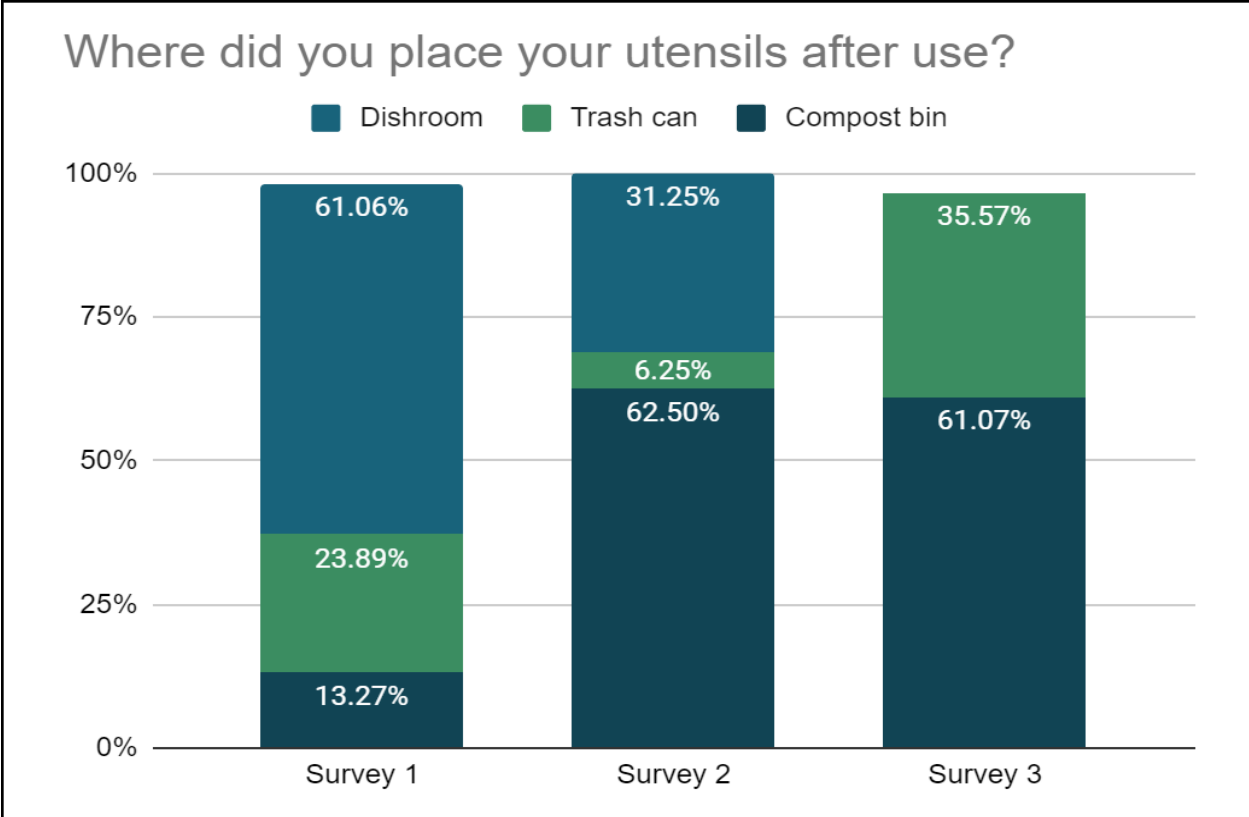


Figure 5. Analysis of students’ tendencies to dispose of compostable utensils supplied by South Quad dining hall. There is a general increase in the number of students who disposed of utensils in compost bins rather than trash bins over time. “Took them to the dish room” wasn’t listed as an option for Survey 3 because at the time the survey was distributed, the dining hall was doing to-go service and taking things to the dish room wasn’t an option.

Where did you place your napkins after use?

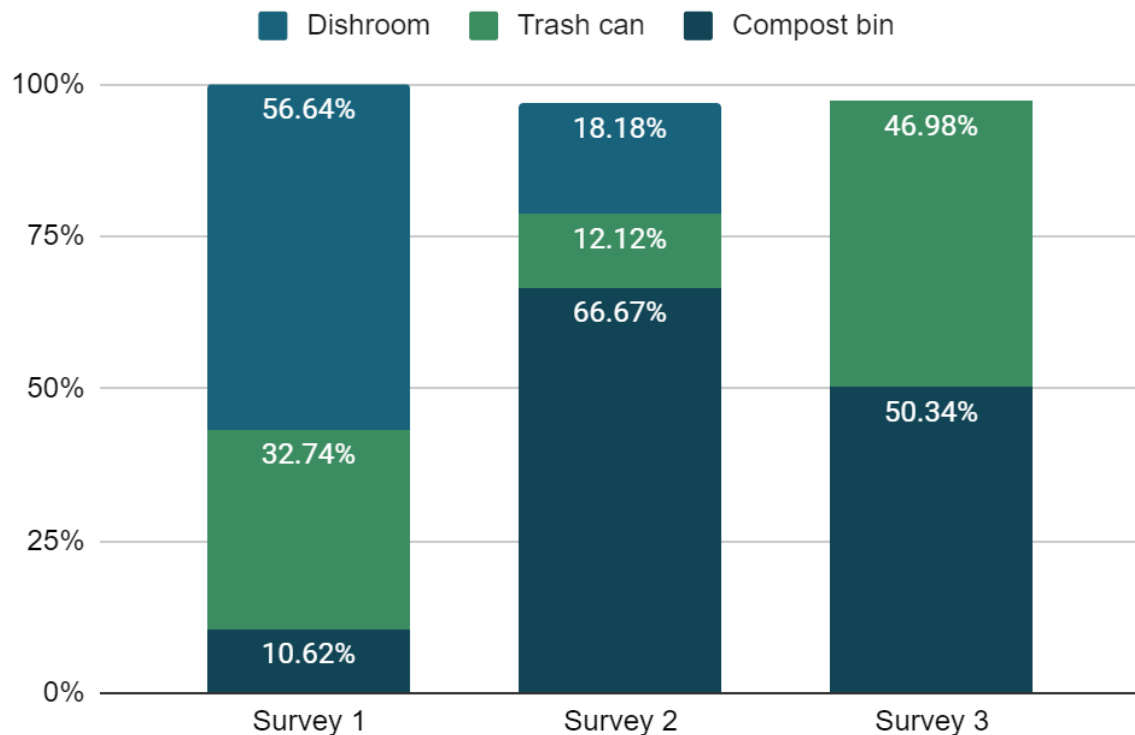


Figure 6. Analysis of students' tendencies to dispose of compostable napkins supplied by South Quad dining hall. There is a general increase in the number of students who disposed of napkins in compost bins rather than trash bins over time. "Took them to the dish room" wasn't listed as an option for Survey 3 because at the time the survey was distributed, the dining hall was doing to-go service and taking things to the dish room wasn't an option.

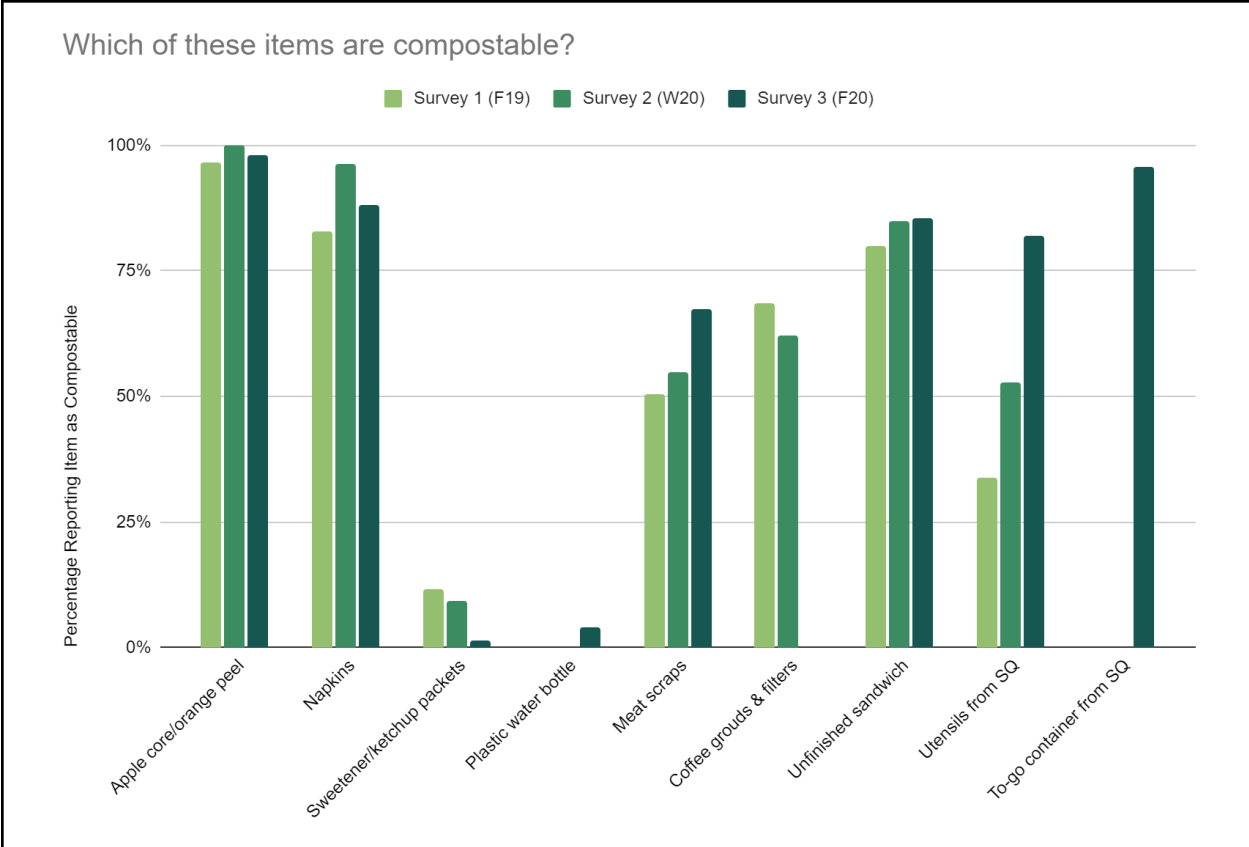


Figure 7. Assessment of compost knowledge. Plastic water bottles and to-go containers from South Quad were only asked about in Survey 3. Most respondents correctly identified food scraps and napkins as compostable, but there was some confusion over meat scraps, coffee grounds, and ketchup/sweetener packets. The only item that saw significantly increased knowledge between the three surveys about whether or not it is compostable was utensils from South Quad.

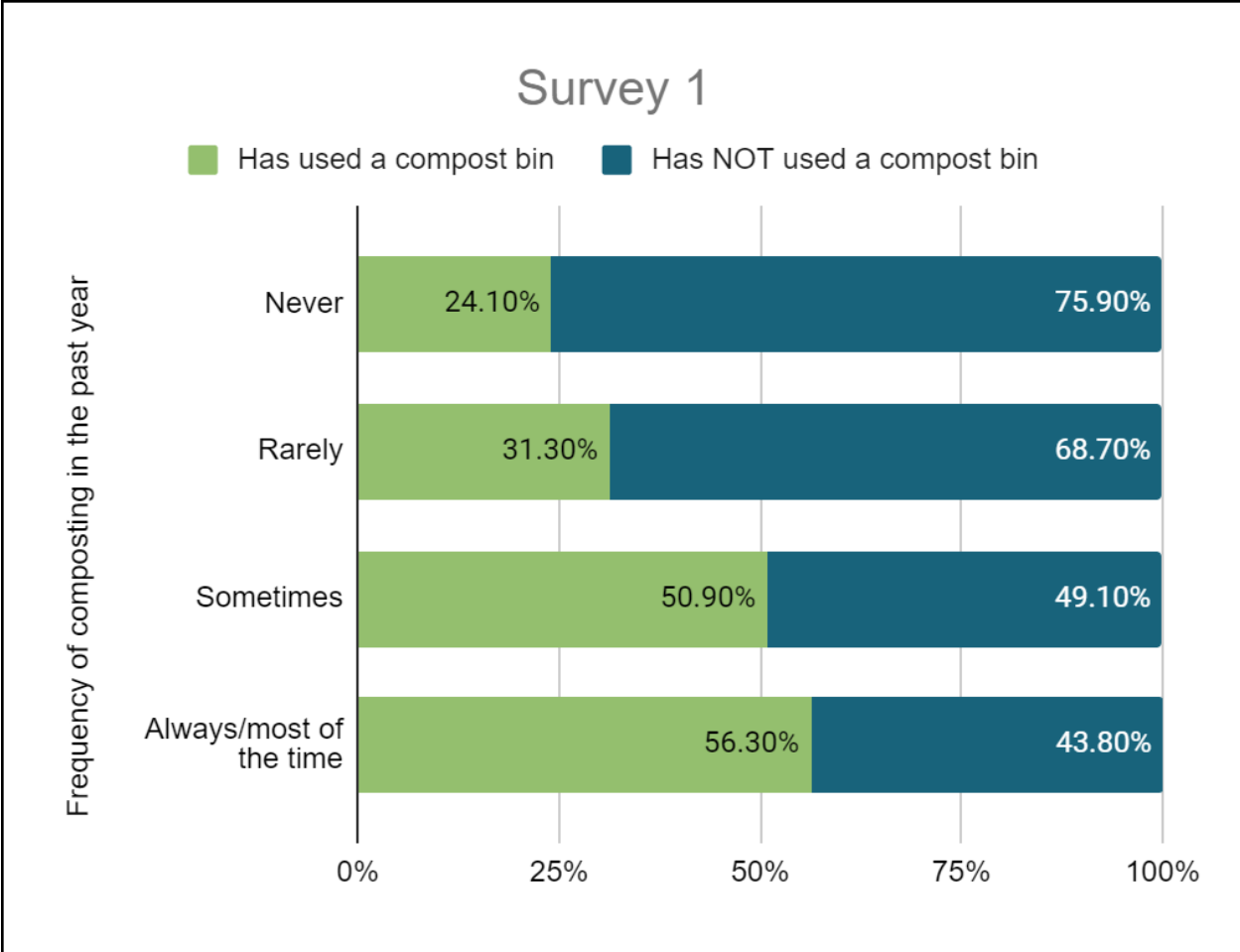


Figure 8. Likelihood of respondents to Survey 1 having used a compost bin in their hall given the frequency of having composted food scraps in the past year. Less than a quarter of students who reported never having composted in the past year said they had used a compost bin in their hall, compared to over half of the students who said they had always composted or composted most of the time in the past year.

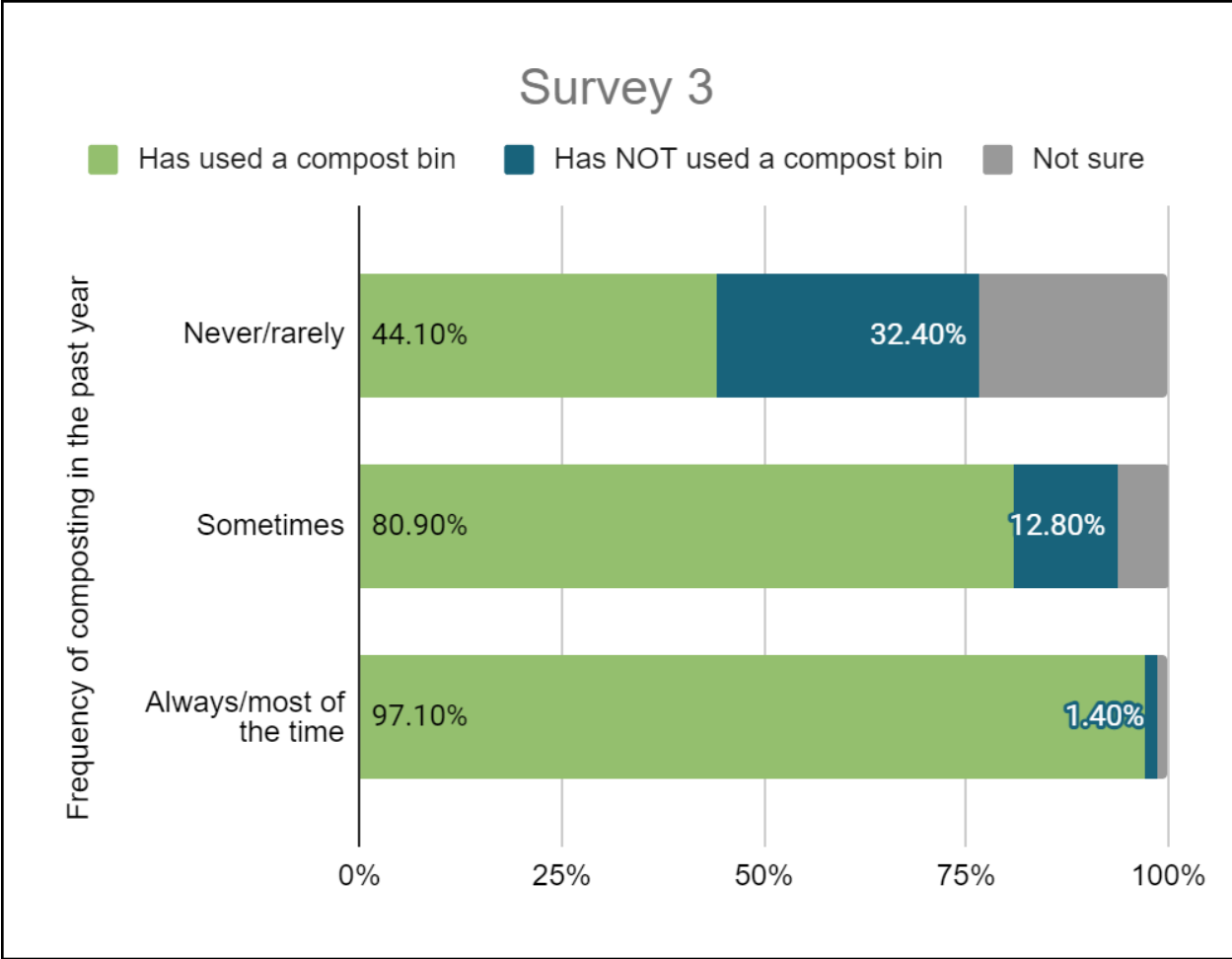


Figure 9. Likelihood of respondents to Survey 3 having used a compost bin in their hall given the frequency of having composted food scraps in the past year. For Survey 3, an option was added for students who were not sure if they had used a compost bin, but the results still show the same trend as with Survey 1 (**Figure 8**). More of the students who reported composting in the past year had used a compost bin in their residence hall than those who didn't.

Sustainability Class vs. Compost Bin Usage (Survey 3)

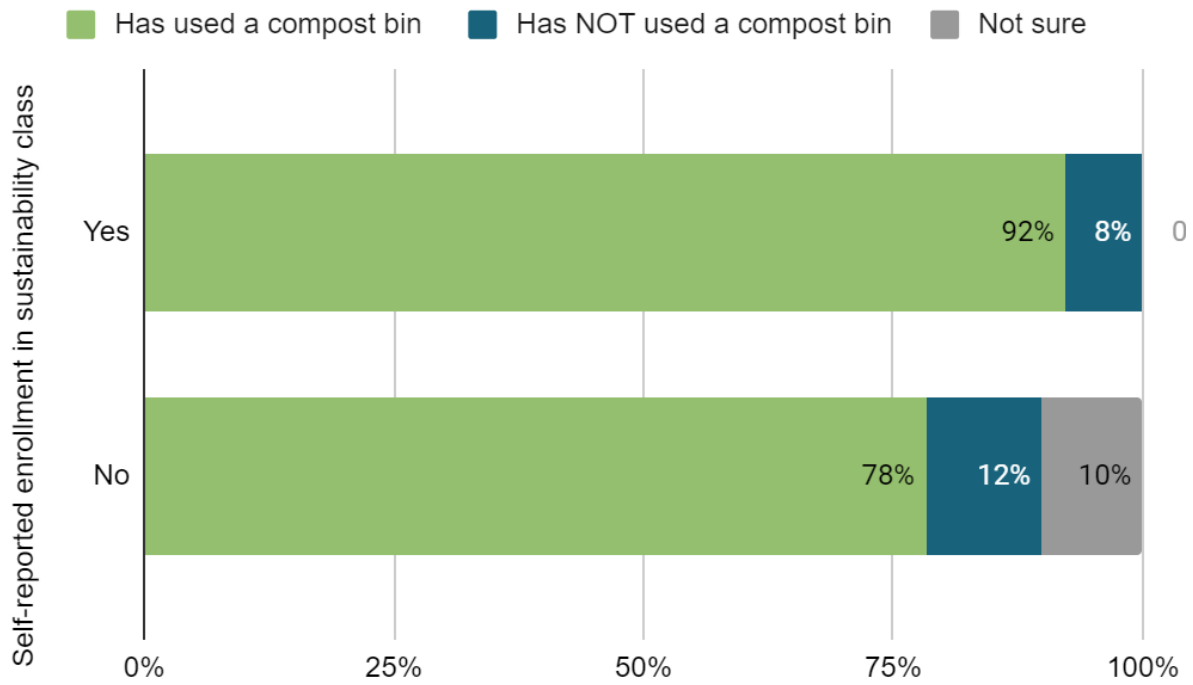


Figure 10. Likelihood of Survey 3 respondents having used a compost bin in their hall given whether or not they self-reported being enrolled in a sustainability-focused class. Respondents to Survey 3 who self-reported being in a sustainability-focused class tended to know more about composting at U-M than students who were not a part of a sustainability-focused class.

Sustainability Club vs. Compost Bin Usage (Survey 3)

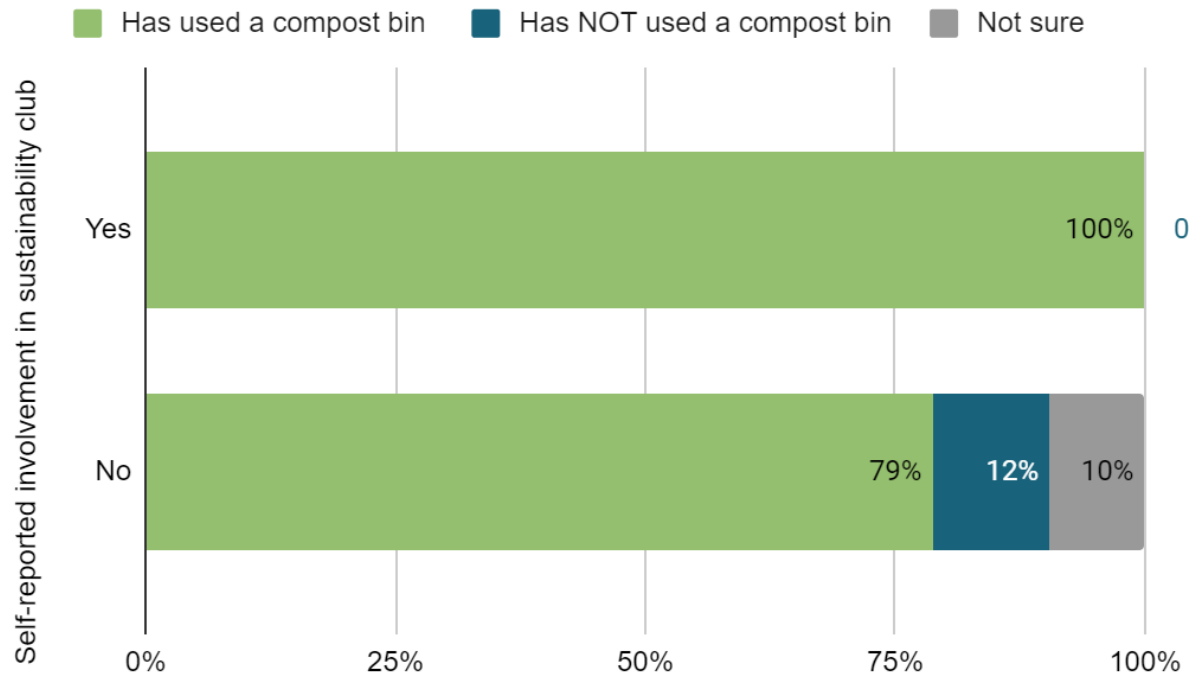


Figure 11. Likelihood of Survey 3 respondents having used a compost bin in their hall given whether or not they self-reported being enrolled in a sustainability-focused club. Respondents to Survey 3 who self-reported being in a sustainability-focused club tended to know more about composting at U-M than students who were not a part of a sustainability-focused club.

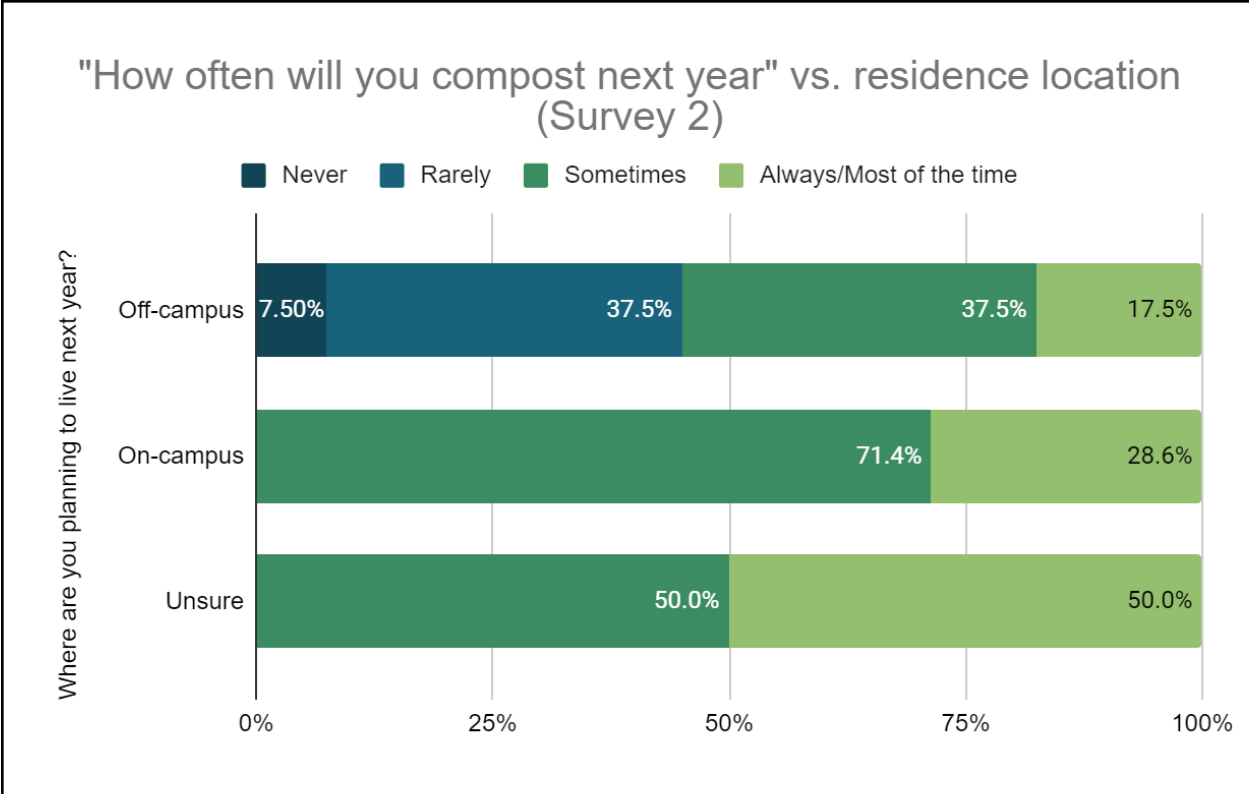


Figure 12. Expected frequency of composting next year (never, rarely, sometimes, or always/most of the time) given respondents' planned living situation next year (on-campus or off-campus) for Survey 2 (Winter 2020). Significantly more students living on-campus the following year said that they plan to compost than students living off-campus.

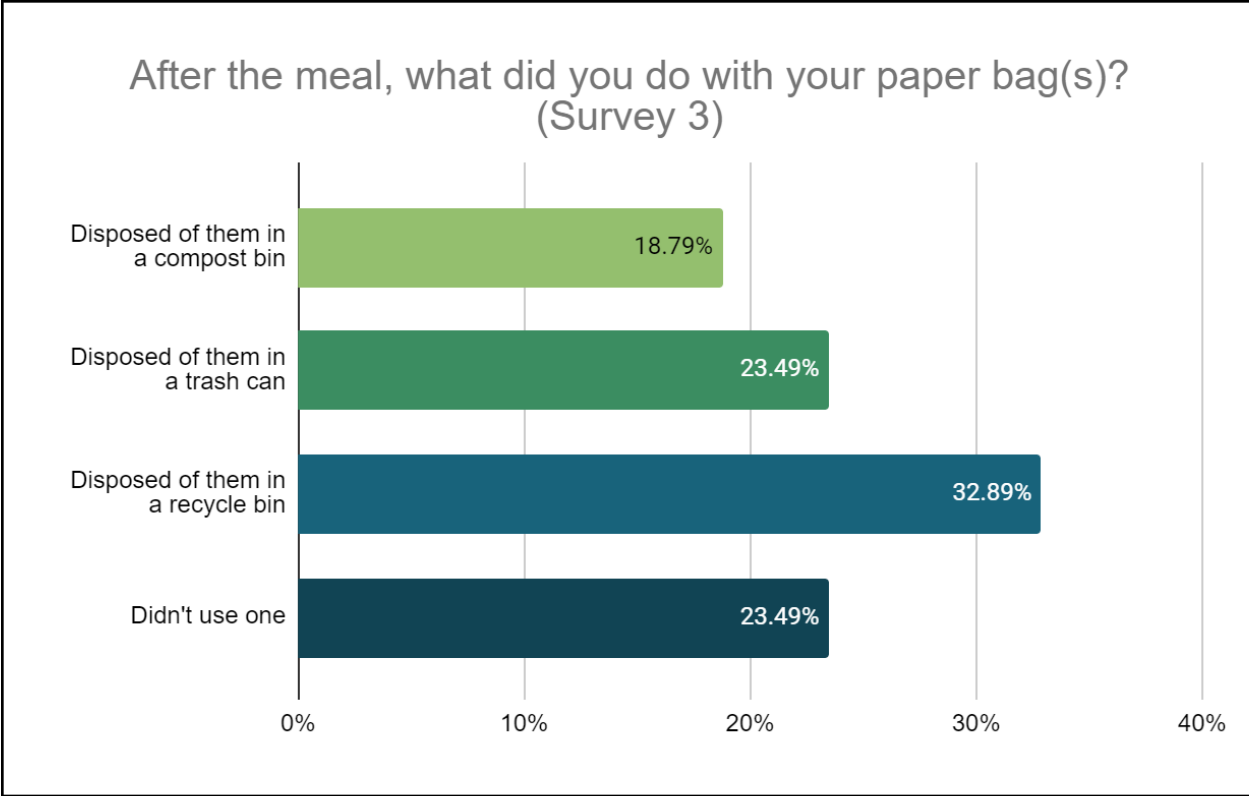


Figure 13. Survey 3 asked what students did with the paper bags that the dining hall distributed with each meal. The survey found that paper bags were most often recycled or thrown in a trash bin, with almost a quarter of respondents said they didn't use the paper bags that were handed out at the dining halls, either because they brought their own bags or simply didn't use a bag.

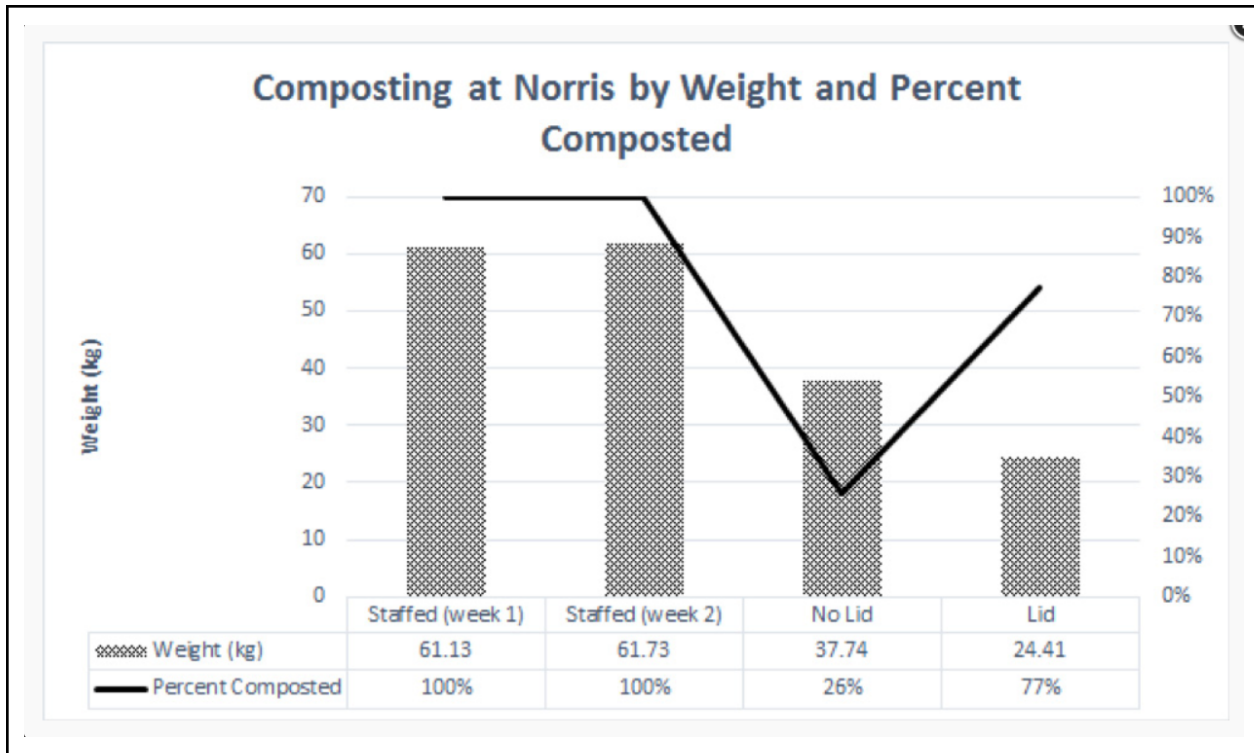


Figure 14. The composting pilot program at Northwestern University that took place in Norris, a large dining space on campus, found that weight and percentage of compost that was accepted by their facility decreased when volunteers were removed, and that acceptance rates increased when lids were placed on the bins. Source: Barton, Olivia, and Vivian Xu. “Composting at Northwestern University Norris Center.” *AASHE*, 20 May 2019.



Figure 15. Standardized signs to be placed above all University of Michigan campus waste receptacles (except for Michigan Medicine and Michigan Dining areas). Source: “Bin Standardization Sign Customization Guide.” University of Michigan Office of Campus

Sustainability.



Figure 16. Michigan Medicine variations of the standardized signs to be placed above all University of Michigan campus waste receptacles. This variation does not include a compost sign because compost bins are not placed in most areas of Michigan Medicine. Source: “Bin Standardization Sign Customization Guide.” University of Michigan Office of Campus Sustainability.



Figure 17. Michigan Dining variations of the signs to be placed above all University of Michigan campus waste receptacles. This variation differs from the standard signs in that the compost signage includes Blue To-Go (MDining cafe service) containers and excludes coffee grounds and filters, which are taken care of by MDining staff. Additionally, the landfill bin features paper cups “from other locations” rather than labeling them as “paper cups” because

the paper cups supplied by MDining are compostable. Source: “Bin Standardization Sign Customization Guide.” University of Michigan Office of Campus Sustainability.