Prompts to Improve Post-Consumer Waste Composting Behaviors in the Student Union Building (SUB)

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CHBE 573

March 25, 2015

UNIVERSITY OF BRITISH COLUMBIA (UBC)

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CHBE 573 SEED Project 4

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Date of Draft: 3/25/2015

Table of Contents

Executive Summary

The Alma Mater Society (AMS) of the University of British Columbia (UBC) is striving to be leaders in campus sustainability by providing resources for student-run sustainability projects and creating in-house initiatives. A current focus is providing new sustainability features, such as on-site composting for new rooftop gardens, in the new Student Union Building (SUB). However, a significant barrier to this project is the level of contamination, in the form of non-compostable waste and materials, within the post-consumer organics bins in the SUB.

The goal of this project is to increase the weight (wt) of compostable waste collected in the compost receptacle opposite ‘Pie R Squared’ in whilst simultaneously reducing the % wt contamination. This was achieved by designing visual behavioural prompts in the form of a large poster and small table toppers. Thorough analysis of literature research on visual prompts led to a design focused on clarity of information, proximity to composting receptacle and positive tone. The contamination after installation of the prompts was compared against baseline data and it has been concluded that both the % wt. contamination and % contamination level were decreased post-intervention. However, the weight of compostable has decreased post-intervention as well. Other compounding factors should be considered when assessing the data, including the sustainability fair occurring during baseline data collection and improvement of old bins with more user-friendly containers post-intervention.

Suggestions for further efforts to improve the quality of compost involve the construction and installation of an audio prompt system based on infrared sensor technology. The infrared sensor would measure the humidity of the waste as a reflection of the content of compostable food waste in the bin. An audio message would play, thanking students who compost their organic material, as positive reinforcement for their good behaviour.

Introduction

Composting at the University of British Columbia (UBC) is a closed loop system. The organic waste produced on campus are made into a useful product for the UBC gardeners to use on university landscapes. The goal of the food scraps collection project is to supply necessary organic material to run through the in-vessel composter. This ongoing success of this program represents a significant step towards making UBC a sustainable campus.

After installing a sustainable composter in the basement of the Student Union Building (SUB) as part of their sustainability initiative in November 2014, the UBC Alma Mater Society (AMS) started using it to compost scraps of food in January 2015 (Pribadi, 1). The composter is a 15-foot stainless steel in-vessel composter called the CityPod. Recently installed in the SUB's recycling room, the composter currently takes care of all pre-consumer food waste from the AMS's catering and food service operations. Food waste from kitchens all around the building is collected in 35-gallon bins lined with compostable bags, and those are shredded with a Bokashicycle Pulveriser before being tossed into the composter, where it will be processed in a short 6 weeks. Once the new SUB opens, compost taken from the CityPod will be used to nourish the herbs and crops growing in the AMS rooftop garden.

According to the United States Environmental Protection Agency, for every one ton of food scraps that is composted, there is a resultant one metric ton avoidance in greenhouse gas emissions. But, contaminants in compost can actually slow down or inhibit the process of composting (Martinson & Tso, 9). Contaminants in composting efforts are typically defined as those materials that either will not break down biologically, such as plastics, or that cause a decrease or elimination of the microbial activity, such as chemical compounds. One of the largest portions of waste on campus is pre-consumer and post-consumer food waste (Baker-French and Richer, 17). It is unwanted, leftover food that has been served to customers as well as compostable disposables. Plate scrapings, apple cores, half-eaten sandwiches, etc. are all collected and composted. Additionally, certified compostable disposables can be collected for composting. These include compostable plates, cups, flatware, bowls, napkins, etc. Often, we find non-compostable items in the green bins – items such as styrofoam, plastic bags, plastic cutlery and plates, metal cutlery, glass bottles, metal cans and even mirrors. Other items that contaminate the final compost product include juice boxes, milk cartons and plastic jam containers.

Students and campus visitors have the desire to properly sort and dispose of their post-consumer waste but it can often be confusing (Lasnier, 1). It's extremely important for users to look at the signs on the bins and make sure they are placing their items in the correct bin, to prevent contamination of material streams. A prompt in a social marketing environment serves an important purpose - a reminder. The primary barrier for the success of the prompt, is the most human of traits - forgetting. Prompts are typically visual or auditory in nature, can be used for a variety of behaviours. To be effective, the messages should be self-explanatory (Kotler and Nancy, 209).

Methodology

Initially, research was conducted on effective behaviour prompts to influence good post-consumer composting habits. A thorough evaluation of literature on audio cues and visual interventions was conducted, as well as interviews with Ivana Zelenika, Zero Waste Coordinator with Campus and Community Planning, to understand the motivation behind compost contamination.

Baseline or the pre-intervention data was collected for one week (Tuesday, Wednesday and Thursday) on February 10-12 by measuring the level of contamination, expressed in percentage of weight (% wt.) of non-compostable contents in the compost bin across from 'Pie R Squared' in the SUB. Weights of the bin and its content were measured using a large scale installed in the recycling room of the SUB.

We classified these wastes as contaminant: plastic bag, plastic fork, plastic spoon, plastic cup, plastic lid, metal can. These wastes were classified as compostable: food scrap, napkin, paper plate.

Level of contamination (% wt. of contamination) is then calculated as a ratio of non-compostable and the total content in a compost bin, as shown below:

$$\text{Level of Contamination} = \frac{\text{wt. non -compostable contents}}{\text{total wt. of content in a bin}} \times 100\%$$

Evaluation of compost contamination was also conducted using a more qualitative 1-4 scale system:

1 = no or very minimal contamination (one, two items)
2 = 3 or more items
3 = approaching 50% contamination
4 = the bin is more than 50% contaminated

After pre-intervention data was collected, visual prompts were then designed on Microsoft Powerpoint for a large 2'x3' poster and smaller 5"x7" table toppers. The large visual prompt was designed and then installed above the compost bin and six smaller table topper prompts were placed at tables in the SUB. The design of the visual prompts will be designed in the next section "Design of Prompts",

Post-intervention data was collected for two weeks on three days of the week (Tuesday, Wednesday and Thursday) on March 3-5 and March 10-12 using the same methods listed above. Data was aggregated and analyzed to determine overall effect of prompt on quality of post-consumer composting. Two quantities are used to gauge the overall effects of the prompt:

1. Percentage of sum of aggregate weight of contaminant, which is percentage of ratio of total weight of contamination over the period of measurement (one week for baseline; two weeks for post-intervention) and the total weight of waste over the same period of time:

$$\text{Percentage of sum aggregate weight} = \frac{\text{total weight of contamination over a period of time}}{\text{weight of total waste over a period of time}} \times 100\%$$

2. Percentage of average contamination level

$$\text{Percentage of average contamination level} = \frac{\sum \textbf{level} \text{ of contamination in \% on each measurement}}{\text{Number of measurement over a period of time}}$$

These two quantities give different indications of the effect of the prompt, as will be discussed in "Results and Discussions" section.

Design of Prompts

Visual prompts as a mean to encourage good recycling and composting behaviours can vary greatly in their effectiveness (Sussman and Gifford, 323). A number of factors impact how visual prompts and signs are remembered. The three major factors that influence waste-sorting behaviour are clarity of information, proximity to receptacles and the emotions they evoke.

The intent of the visual prompts design was to inform consumers of the eventual fate of their food scraps based on several studies that identify ignorance as a leading cause of poor composting habits (Austin, et al., 247 and (Vining, 55). Consistent with the vision of AMS Sustainability, the theme of the poster was 'Close the Loop' which connects students composting behaviour to a greater purpose with tangible effects of providing rich compost for AMS rooftop gardens. This connection could positively influence behaviour by informing SUB consumers of the importance of composting to their immediate community.

The poster and table toppers were also designed to be in close proximity to the compost bin because placing the behavioural prompt in near the opportunity to exercise a particular behaviour has been proven to be more effective than when placing it more than 5 metres away (Werner et al., 709). The large 2'×3' poster was placed directly above the waste bins and separately formatted 5"×7" table toppers were placed on tables in the immediate area in the SUB main floor lounge. Research shows that large posters tend to be more effective than small ones, unless viewers have the opportunity to focus on the small prompts, as would be the cases if they were sitting down to eat at the table in the lounge (Sussman and Gifford, 323).

Lastly, studies reveal that putting readers in a good mood, achieved through positive language and colourful visuals may encourage recall (Sussman and Gifford, 596). Hence, the poster was designed with a simple but vivid colour pallet, and encouraging tone. Use of reprimanding tones can result in reactance, or intentional defiance of prompt but good moods have been shown to encourage recalling of behaviour at future opportunities. Additionally, ambiguity was removed from the message by ensuring clear, concise instructions for 'closing the loop' at UBC.

The final design of the poster and table topper prompts are shown in Figure A-1 and A-2 in Appendix A.

Results and Discussion

The baseline measurement of contamination level was performed on February 10-12 before the waste prompt intervention to get a baseline. Further measurement was undertaken on the week of Mar 3-5 (Week 1) and the week of Mar 10-12 (Week 2) to quantify the effectiveness of the prompt. All the data are given in Table B-1 in Appendix B.

Figure 1 in the next page shows the level of contamination in term of weight during the baseline and the first two weeks of intervention. The baseline data shows low contamination on Tuesday and Thursday, but high on Wednesday. This situation may be caused by the sustainability fair on that Tuesday, which encouraged proper waste sorting and consequently resulted in a reduction of the level of contamination on Tuesday. Drop in the contamination levels was most clearly observed on March 4 (Wednesday) of Week 1 and March 11 (Thursday) on Week 2. The level of contamination on March 4 is similar to the level observed on the day sustainability fair. Therefore, we may conclude that the sustainability event may have provided a similar effect to the waste prompt. Meanwhile, the data on Thursday showed a good albeit late progress of reduction in level of contamination; about 1% of contamination was observed in the compost bin.

Table 1 shows that the waste prompt intervention resulted in a reduction in the average and the aggregate percentage of contamination. It is worth noting that on the first day of the baseline measurement, the sustainability fair was held in the main floor of AMS, very near to our target compost bin. Because some hands-on instructions for composting were given during the event, the level of contamination is substantially lower compared to the other two days of the week.

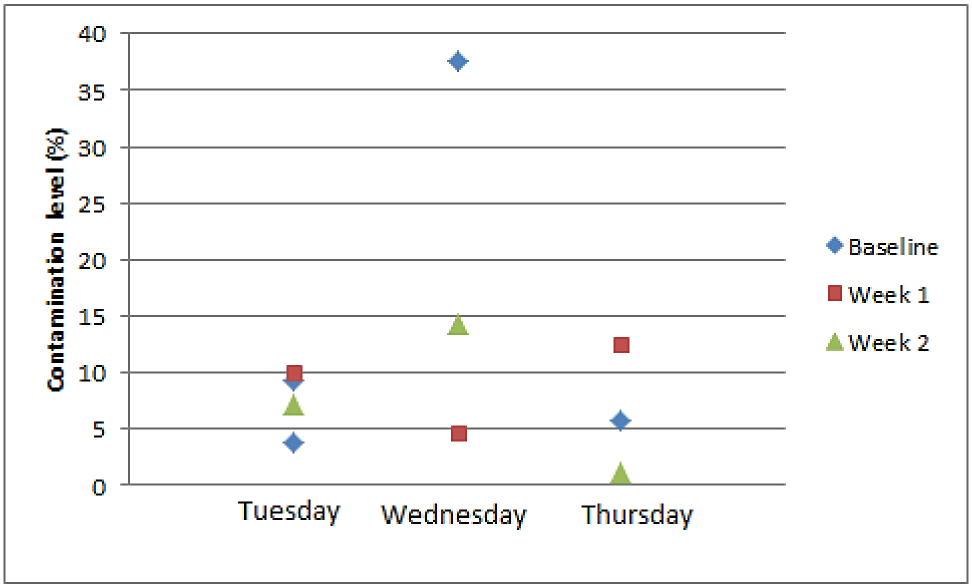


Figure 1: Level of Contamination in Compost Bin before and after Intervention. On Tuesday of the baseline week, the contents of two compost bins were measured.

Table 1: Aggregated data before (baseline) and after intervention (week 1 and week 2)

	Total Waste (kg)	Contaminant (kg)	Compostable (kg)	Aggregated Percentage of Weight of Contamination (%)	Average Contamination level (%)
Baseline	16.3	1.4	14.9	9%	14%
Week 1	3.5	0.25	3.25	7%	9%
Week 2	4.4	0.31	4.09	7%	8%

Nevertheless, the level of contamination has experienced a decrease after waste prompts was implemented, which are 3% reduction for average contamination level and 5% reduction for aggregated percentage of weight of contamination. As one can see, the two quantities: average contamination level and aggregated percentage of weight of contamination give slightly percentage change; aggregated percentage of weight of contamination gives a lower percentage of contamination than average level of contamination. Nevertheless, these results shows that the prompts gave a positive impact to student's waste sorting behaviours.

On another hand, the prompts do not appear to encourage students to put food waste in the compost bin. The total amount of the compost waste on week 1 and week 2 after intervention is less half of the amount on the baseline week.

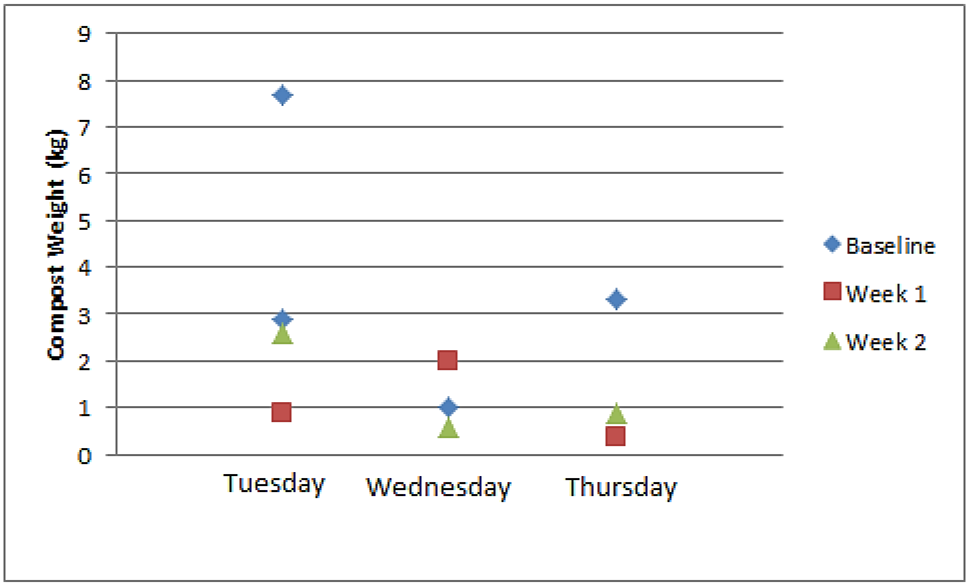


Figure 2: The compost weight in kg before (Baseline) and after (Week 1 and Week 2) after the intervention.

The increased weight of compost waste observed is one of the main purposes of implementing prompt intervention. On the contrary to our objective, Figure 2 shows that the intervention only increased the amount of compost on Wednesday (March 4) of the first week. Although the amount of waste is still below the baseline on Tuesday and Thursday, it shows that the amount of waste increases from the first week to second week. As mentioned above, the prompt was installed at the same time as the "Sort it Out" signage. At the very first week after setting the bin signage, people might have been confused and put their waste in the garbage as an easier way dealing with the "new rule". After certain period of time, people got used to and understood how to sort their own waste and began to feed the compost bin again. More data on longer-period of waste prompt implementation may give a better interpretation of the effect of the prompt.

Suggestions for Further Research

The initial idea was to implement an audio prompt system based on infrared sensor technology. Infrared sensor collects the humidity level of the environment. Microprocessor correlates the humidity to the moisture content and then decides whether to play a message to asking students for food waste based on required moisture content. The moisture content to facilitate an optimal composting are said to be 40% to 60% by total mass basis according to recommendation by Cornell Waste Management Institute. The infrared sensor can be implemented as shown in the diagram below.

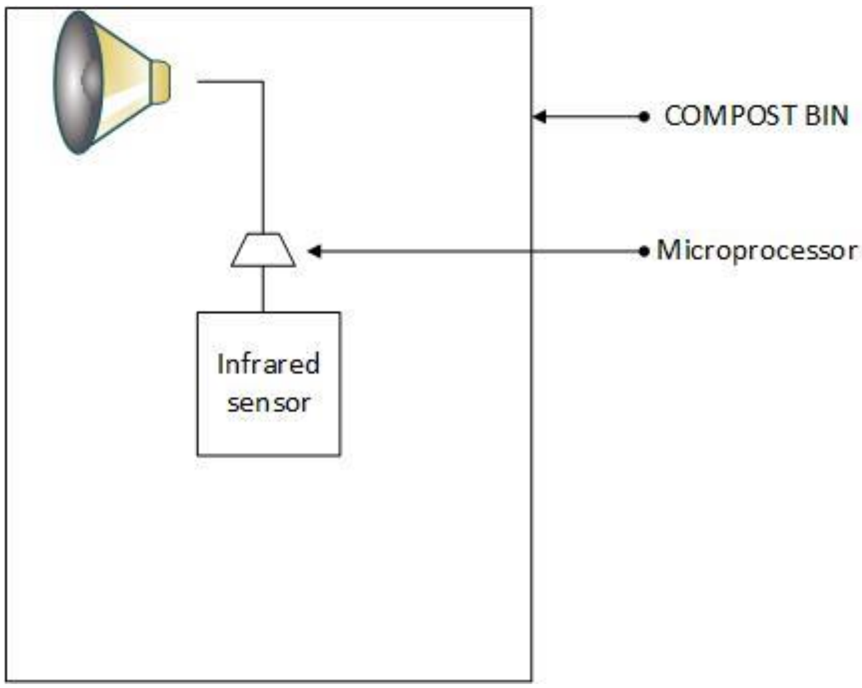


Figure 3: The sketch of the implementation of infrared sensor.

Due to the high price of electronic humidity analyzer, e.g. $700 for OMEGA Pinless Moisture/Relative Humidity Meter with Infrared Thermometer (OMEGA website), we can remove the analyzer and simply play an audio message asking students to throw their food waste into the bin every 15 minutes. An audio message can also be played to thank the students as positive reinforcement for their good behaviour.

We suggest that the sorting should be performed at two or more different bins so that we can confirm the variations between bins. For our case, two compost bins are very close to each other. Bin A, which is the one we focused on, is located right opposite the Pie R Squared pizza store while another (Bin B) is located at the corner of the SUB main floor lounge (see figure 4). These two bins are very close in proximity. On Feb 10, when the sustainability fair was held in the SUB, Bin B collected more material than Bin A as shown in Table B-1. Since that is the only day where we measured the contamination of two bins, we are unsure whether this phenomenon is consistent. It is likely due to the fact that Bin B is closer to the sitting area in the SUB Lounge. Hence, when students have eaten their food, they will throw the waste into a compost bin closer to the lounge, which happens to be Bin B.

As for the location of the poster, we suggest to place it closer to the Lounge compost bin, so that the students will see it when they are having their food. Additionally, a study can be conducted across all four streams in order to discover poster effect to amount of weight and level of contamination toward each bin. By this observation, we might know not only contaminant in the compost bin, but also level of the food scraps that being placed mistakenly.

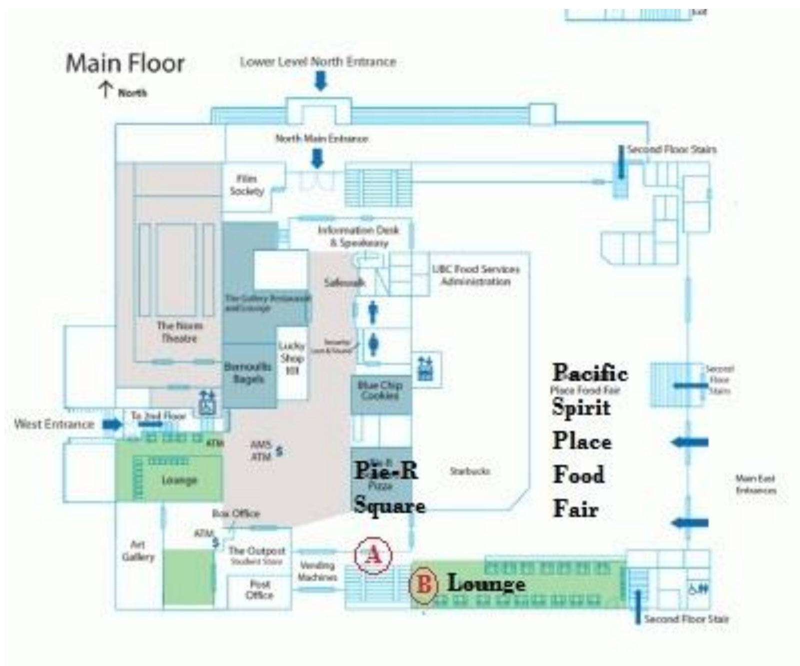


Figure 4: Locations of compost bin A and bin B (UBC AMS)

Works Cited

Alma Mater Society at University of British Columbia (AMS UBC). “At the SUB.” Assessed on 19 Mar. 2015. <http://www.ams.ubc.ca/at-the-sub/>.

Austin, John, David B. Hatfield, Angelica C. Grindle and Jon S. Bailey. “Increasing Recycling in Office Environments: The Effects of Specific Informative Cues.” *Journal of Applied Behavior* Analysis. 26 (1994): 247-252. Print.

Cornell Waste Management Institute. "Cornell Composting: Moisture Content." 1994. Web. Assessed on 19 Mar. 2015. <http://compost.css.cornell.edu/calc/moisture_content.html>.

Kotler, Philip, and Nancy Lee. "Influencing Positive Public Behaviors: Social Marketing” Marketing in the Public Sector: A Roadmap for Improved Performance. Upper Saddle River, N.J.: Wharton School Pub., 2007. Print.

Lasnier, Guy. "Composting Bins Promote a Handy Diversion toward 2020 Zero-waste Goal." University of California Santacruz Newscenter. 1 Dec. 2014. Web. <http://news.ucsc.edu/2014/12/zero-waste-project.html>.

Martinson, Sumner, and Saiping Tso. "Guide to Agricultural Composting." Commonwealth of Massachusetts. 1 Jan. 2011. Web. <http://www.mass.gov/eea/docs/agr/programs/compost/guidetoagcomposting2011.pdf>.

OMEGA. “Pinless Moisture/Relative Humidity Meter With Infrared Thermometer”. Assessed on 20 Mar. 2015. <http://www.omega.ca/pptst/RH297.html>.

Pribadi, Sarah. "AMS Hopes to Control Smell Coming from New Composter." The Ubyssey. 18 Mar. 2015. Web. <http://ubyssey.ca/news/ams-hopes-control-smell-coming-new-composter-next-week/>.

Sussman, Reuven and Robert Gifford. “Be the Change You Want to See: Modeling Food Composting in Public Places.” *Environment and Behavior*. 45.3 (2011): 323-343. Print.

Sussman, Reuven and Robert Gifford. “Please Turn Off the Lights: The Effectivenes of Visual Prompts.” *Applied Ergonomics*. 43.3 (2012): 596-603. Print.

Baker-French, Sophia and Liska Richer. "UBC Sustainable Campus Food Guide." (2013): 17. *UBC Sustainability*. UBC Food System Project. Web. <http://sustain.ubc.ca/sites/sustain.ubc.ca/files/images/UBCSustainableCampusFoodGuide.pdf>

Vining, Joanne. “What Makes a Recycler? A Comparison of Recyclers and Non-Recyclers.” *Environment and Behavior*. 22 (1990): 55-73. Print.

Werner, Carol, M., Mark U. Rhodes and Kimberly K. Partain. “Designing Effective Instructional Signs With Schema Theory.” *Environment and Behavior*. 30.5 (1998): 709-735. Print.

Appendix A: The Final Design of the Prompts

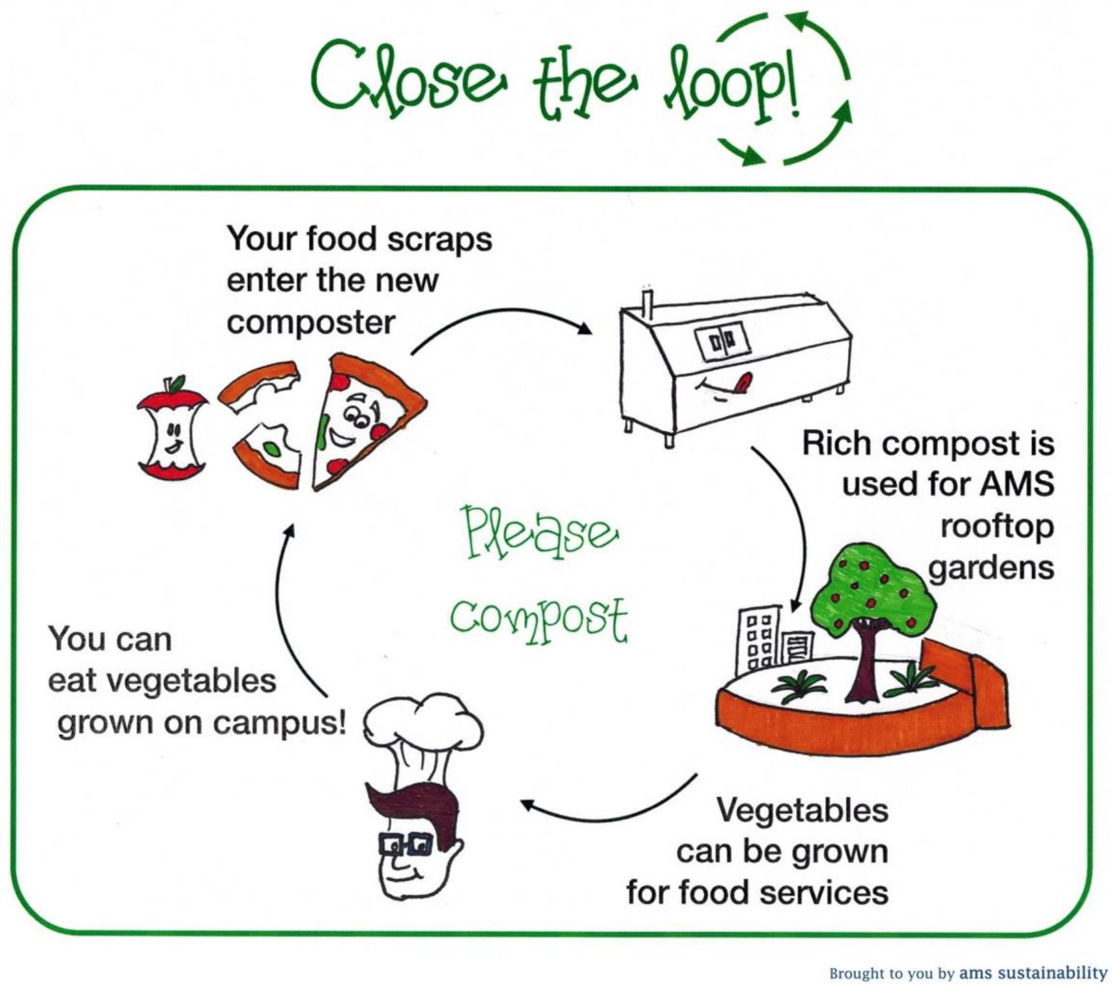


Figure A-1: The design of large poster, which was displayed on the glass screen opposite Pie R Square.

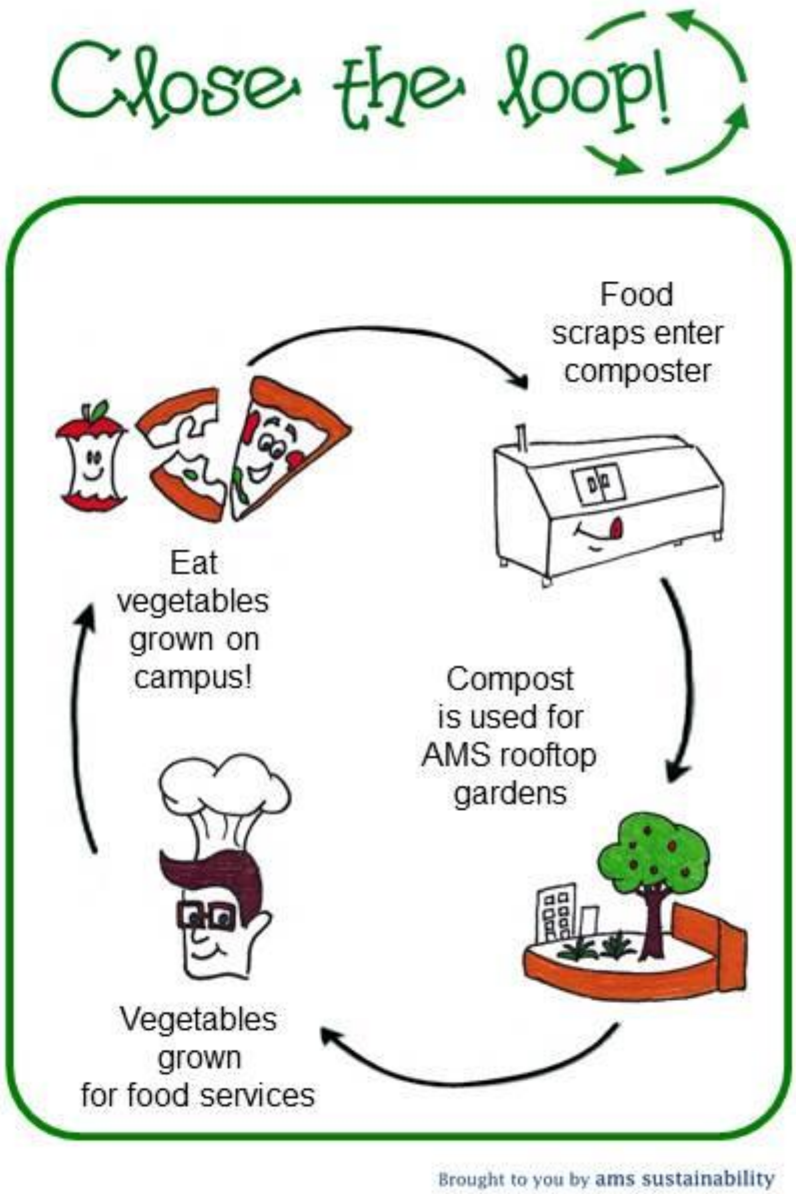


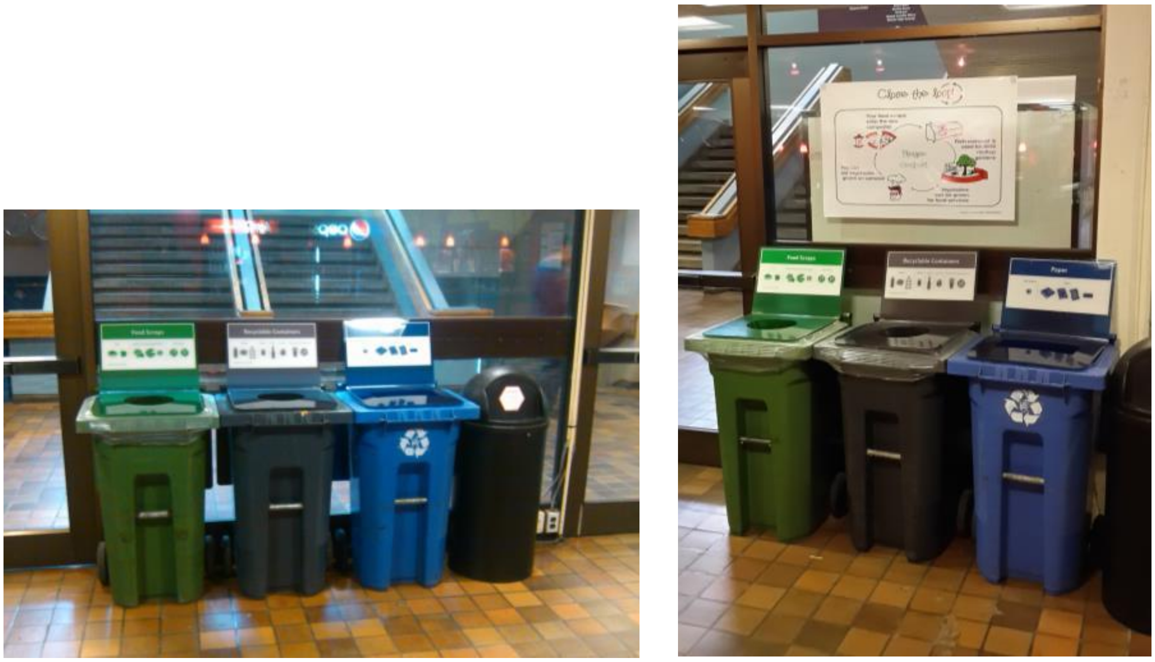
Figure A-2: The design of table topper (5” × 7”), which is placed onto the tables in the tables in the lounge in main floor of the UBC Student Union Building.

Appendix B: Additional Information

Table B-1: Baseline and After Intervention Data of Across "Pie R Squared" Pizza Compost Bin Sorting

Week	Month	Day	Total Content (kg)	Contamination (kg)	Compostable (kg)	Contamination Rating (1-4)	Contamination Level (% total weight)	location	Remark
Baseline	Feb	10	3.2	0.3	2.9	2	9.38	across Pie R Square	full of paper plates, Starbucks, manchuwok , generic
Baseline	Feb	10	8	0.3	7.7	2	3.75	after the corner of Pie R Square	full of paper plates and one large pizza box
Baseline	Feb	11	1.6	0.6	1	2	37.50	across Pie R Square	compost: paper plates, pizza crust, fruit peel and contamination: coffee cups, subway wrappers
Baseline	Feb	12	3.5	0.2	3.3	2	5.71	after the corner of Pie R Square	boulevard, Dixie, white unknown bowls, compost: paper plates, medium size pizza box
1	Mar	3	1.0	0.1	0.9	1	10.00	across Pie R Square	1 generic cup, small plastic and small dessert cup
1	Mar	4	2.1	0.1	2	1	4.76	across Pie R Square	1 A&W cup, generic meal cup
1	Mar	5	0.4	0.05	0.35	1	12.5	across Pie R Square	contamination by coffee cups and plastic spoons
2	Mar	10	2.8	0.2	2.6	1	7.14	across Pie R Square	a lot of organic waste (fruit peals, uneaten pie, noodles) and contamination was cups and plastic take-out containers
2	Mar	11	0.7	0.1	0.6	1	14.29	across Pie R Square	contamination by plastic sushi box, plastic bag fasteners and coffee cups
2	Mar	12	0.9	0.01	0.89	1	1.11	across Pie R Square	almost perfect: plastic fork, cup lid

Appendix C: Photos



(a) (b)

Figure C-1. The bins across ‘Pie R Squared’ SUB UBC (a) before intervention (b) after intervention

Figure C-2. The Table Topper installed in the lounge table

(a) (b)

Figure C-3. Waste in compost bin before sorting (a) top view of compost bin (b) poured out from compost bin

Figure C-4 The sorted waste