The Effectiveness of 3D Display Cases In The AMS Nest

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GRS 397B

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Abstract

The purpose of this study is to determine the effectiveness of 3D display cases on Sort-It-Out stations in the Alma Mater Society (AMS) Student Nest. Qualitative and quantitative observations of bin users were conducted before and after 3D display cases were installed on the Sort-It-Out station by Pie-R Squared. The sorting behaviour of users was observed by recording the waste stream that was used to dispose of specific waste items and determining if the sorting decision was correct or incorrect. The comfort levels of users were also recorded by observing verbal and body language cues. The findings of this study will be useful in determining if 3D displays improve waste sorting behaviours, and can inform decisions about the signage on sorting stations in the Nest in the future.

Introduction

UBC has a Zero Waste Action Plan (ZWAP) and the AMS has the Lighter Footprint Strategy (LFS) outlining zero waste targets that include the ZWAP objective to increase waste-diversion rates, and the LFS targets to address waste within AMS operations ("UBC Vancouver Campus Zero Waste Action Plan (Rep.)", 2014; AMS Sustainability, 2014). The Sort-It-Out stations in the Nest are part of the larger campus-wide zero waste initiative to replace garbage cans on campus with multi-bin waste stations in order to reach the waste-diversion targets outlined in the ZWAP ("Sort It Out", n.d.). Sort-It-Out stations have four waste streams that include compost, recyclables, paper, and garbage; and have 2D signage (see "Figures 4-7" in Appendix) that was designed to aid users with their waste sorting decisions. A study from Carnegie Mellon University determined that 2D signage on waste stations does not actually catch the attention of waste station users, which leads users to check the contents of each bin for

guidance (Chung, Gaw, Guarino, and Parnes, 2011). A study from the University of Washington determined that 3D displays on waste stations are more effective signage than 2D displays, as disposal bins with 3D displays had higher than average accumulations of compostables and recyclables relative to trash during a two-month study; which suggested users were both seeing and using the 3D displays to inform their sorting decisions (Johnson, 2013; "Easing the Disposal Dilemma in the Husky Den", n.d.). In alignment with the zero waste initiatives of the ZWAP and LFS, and the findings of the studies by Chung et al. (2011) and Johnson (2013), the objective of this case study is to determine if 3D display cases on the Sort-It-Out station by Pie-R Squared (an AMS Food and Beverage outlet) will improve waste sorting habits of specific items into the correct waste streams.

Research Question

How do 3D display cases on the Sort-It-Out station by Pie-R Squared affect the sorting of specific items into the waste streams?

Hypothesis

3D display cases on the Sort-It-Out station by Pie-R Squared will improve waste sorting habits of specific items into the correct waste streams.

Background

The waste streams in the AMS Nest are poorly sorted, despite Sort-It-Out stations. The Nest is the new AMS building on the UBC Vancouver campus that was built to be a sustainable centre of student activity ("About The Nest", n.d.). The doors to the Nest opened to students,

faculty and staff in the summer months of 2016, officially replacing the Old Student Union Building (SUB). Current unpublished research conducted in the form of a waste audit organized by UBC's largest student-run sustainability club on campus, Common Energy, determined that in March 2014, 73% of the waste in the garbage streams in the Old SUB was incorrectly sorted, and could have been redirected into the other three streams. In March 2016, a waste audit was conducted of the Nest that determined 80% of the waste in the garbage stream was incorrectly sorted, suggesting that waste-sorting behaviours of users worsened from the Old SUB to the Nest. Given the results of the waste audits, in order to reach UBC's target of 80% waste diversion for the whole campus by 2020, waste-sorting behaviour in the Nest needs to improve ("UBC Vancouver Campus Zero Waste Action Plan (Rep.)", 2014).

Johnson (2013) (see "Introduction") suggests that 3D displays on multi-bin waste stations provide better guidance than 2D displays to users regarding waste sorting decisions, and thus improve waste-sorting behaviours of users. The most relevant and accessible research on 3D waste displays at UBC is limited to the SEEDS projects currently being conducted on the Vancouver campus. Ivana Zelenika, a PhD candidate, is conducting concurrent studies on the effectiveness of 3D display cases at UBC in the CIRS and Henry Angus buildings. Her study is focusing on the effects of different waste bin signage and displays on sorting behaviour by creating a ratio of the contamination count (of each bin) versus the weight of material collected (from each bin) in kg (Ivana Zelenika, personal communication, 2016). Another SEEDS project being conducted by students in a PSYC 321 class is focusing on the use of 3D display cases by people who are sorting their waste (Fu, Siu, and Misra, 2016).

Methods

To conduct this study, 3D display cases with example waste items were installed on the Sort-It-Out station by Pie-R Squared in the Nest, and sorting behavior was observed. The Sort-It-Out station by Pie-R Squared was chosen for this study because it caters to a smaller section of the Nest and only one outlet (Pie-R Squared). For this study it was critical that the researcher was able to accurately monitor the sorting decisions made by each visitor to the station, and thus the lighter traffic around the station made it more desirable than other stations throughout the Nest.

Figure 1. The Sort-It-Out station by Pie-R Squared in the AMS Nest prior to 3D display case installation.

Specific waste items (packaging items sold at food outlets in the Nest) were chosen for observation in this study based on observations made of the waste in the Sort-It-Out station prior to the study: items that appeared most frequently in the waste streams of the station by Pie-R Squared were chosen. By choosing a specific number of items, the data collected was easier to compare upon completion of the observations. Some of the items chosen for observation were not conducive to the size and shape of the cases, and therefore, had to be left out of the cases. These items included: clear plastic containers and noodle boxes. Pie-R Squared pasta containers were also not included in the cases as the outlet discontinued their sale after the study had begun.

Table 1. Items in 3D display cases categorized by waste stream.

Stream	Compost	Containers	Paper	Garbage
Items	Pizza plate, napkin, brown baked-goods bag, soup bowl, chopsticks, and sushi container bottom	Qoola cup, Qoola spoon, fork, pop can, coffee cup and lid, and sushi container top	Newspaper, used notepaper, and coffee cup sleeve	Granola bar wrapper, plastic straw, and soy sauce packet

*See Figures 8-12 in the Appendix for pictures of each case with the above-mentioned items inside and an overview of the whole station with the cases installed.

For this study, two rounds of assessments were conducted. Initially, baseline assessments were conducted between 10:15am-1pm on February 9th, 23rd, and March 1st prior to the installation of the 3D display cases. Following the installation of the cases, secondary assessments were conducted between 10:15am-1pm on March 22nd, 29th, and April 5th.

The subjects for study are the users of the Sort-It-Out stations in the AMS Nest: students, faculty, staff, and visitors. This study relied on both quantitative and qualitative observations of the users. The researcher quantitatively observed the number of individuals who sorted their waste, prior to the 3D displays in place, and after they have been installed. An observation chart (see "Figure 13" in Appendix) was used to record which waste stream was used to dispose of specific items. One tally on the chart was equivalent to one user, regardless of how many of the same item the individual was carrying. For example, if one user was disposing of four napkins, only the user is counted because the recording process is based on the decision of the individual. However, if the user had multiple different items (ex. a pizza plate and a napkin and a pop can), then that would be counted as three because the user is making three different disposal decisions. After the data was collected in the chart, the correct stream for the specific items were highlighted and it was determined how many of the items were correctly or incorrectly sorted. Using a chart that required the researcher to record which stream was used to dispose of specific

items, rather than requiring the researcher to determine whether the users' choice was correct at the time of disposal, mitigated researcher error. The number of correctly and incorrectly sorted items was then put into individual tables per assessment (see "Figure 14" in Appendix). The researcher also qualitatively observed and recorded the body language (shifting eyes, speed of disposal, etc.) and verbal cues (ex. "I don't know how to do this", etc.) of individuals to determine comfort levels as they approached the bins.

Results

Quantitative

Tables 2 and 3 below show a tabulation of the data collected via observation during the two assessment periods.

Table 2. Totals of the data collected during the baseline assessment period.

Item	Correctly Sorted	Incorrectly Sorted	Total Items Disposed
Coffee cups	12	5	17
Coffee cup sleeves	4	1	5
Napkins	96	67	163
Pizza plates	154	99	253
Soup bowls	1	0	1
Qoola cups	0	3	3
Qoola spoons	2	1	3
Clear plastic containers	2	1	3
Utensils	2	1	3
PieR pasta containers	0	0	0
Brown bags	5	5	10
Popcan	53	1	54
Sushi tops	5	7	12
Sushi bottoms	6	6	12
Chopsticks	1	8	9
Noodle boxes	1	3	4

Table 3. Totals of the data collected during the secondary assessment period.

Item	Correctly Sorted	Incorrectly Sorted	Total Items Disposed
Coffee cups	8	1	9
Coffee cup sleeves	4	1	5
Napkins	150	44	194
Pizza plates	203	69	272
Soup bowls	4	1	5
Qoola cups	1	2	3
Qoola spoons	1	2	3
Clear plastic containers	1	2	3
Utensils	2	1	3
PieR pasta containers	n/a	n/a	0
Brown bags	5	2	7
Popcan	63	1	64
Sushi tops	5	2	7
Sushi bottoms	7	1	8
Chopsticks	6	1	7
Noodle boxes	3	0	3

Only the napkin and pizza plate results will be outlined, as the other items do not have significant enough sample sizes (see "Table 2" and "Table 3" above). The baseline assessment determined that 59% of napkins and 61% of pizza plates were sorted correctly without the aid of 3D display cases.

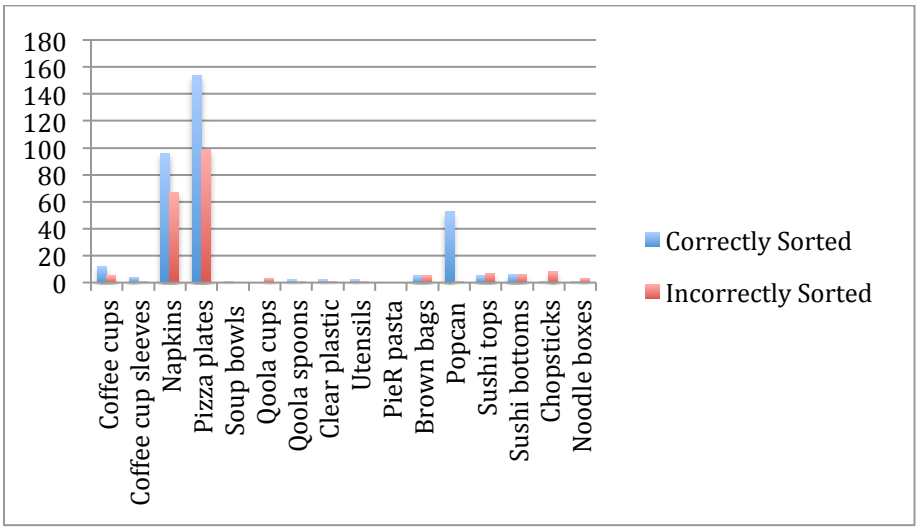


Figure 2. Baseline assessment data showing the number of correctly and incorrectly sorted items.

Following the implementation of the 3D display cases it was found that 77% of napkins and 74% of pizza plates were correctly sorted.

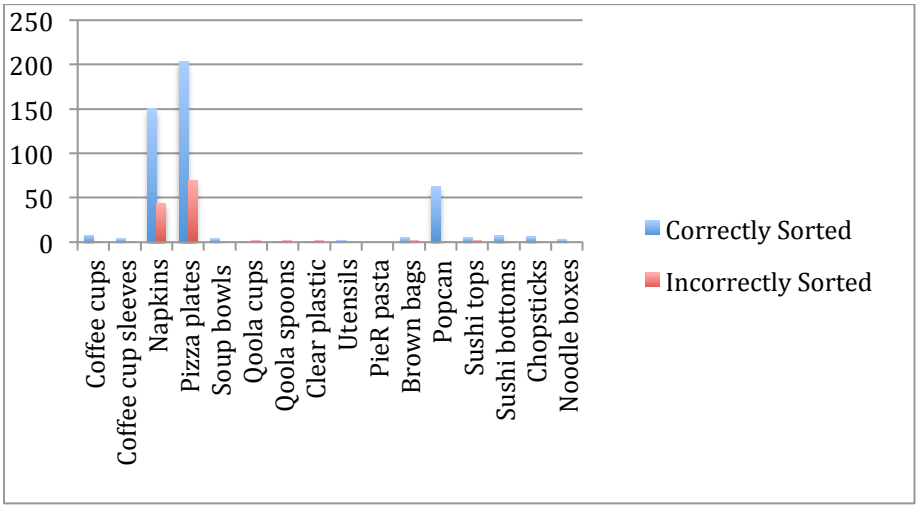


Figure 3. Secondary assessment data showing the number of correctly and incorrectly sorted items.

When a Z-test for 2 proportions was used to calculate the significance, it was determined that the p-value for the difference in proportions for pizza plates is 0.0008 and the p-value for the difference in proportions for napkins is 0.00018. These p-values indicate that the increase in correctly sorted napkins and pizza plates is significant.

Qualitative

'Uncertainty', 'hesitation' and 'disengaged' were three key words that stood out from observations recorded during the baseline assessment period. It was observed that some users made attempts to sort correctly, while others disposed of their waste items directly into the garbage stream without attempting to sort. It was also observed that many users relied on peering into the bins to determine if their items belonged there; which was also a pattern during the secondary assessment period. Throughout the secondary assessments it was observed that people

appeared to be analyzing the cases and basing their sorting decisions on them. However, it was also observed that some people did not appear to even notice or look at the cases.

Discussion

Given the statistical significance of the increase in correctly sorted napkins and pizza plates, it can be concluded that 3D display cases have the potential to improve waste sorting habits in the AMS Nest. These results align with the hypothesis of this study, and the findings of the study of Johnson (2013), which determined that 3D display cases improve waste sorting.

The PSYC 321 Project 3D that conducted a survey with 3D display cases at the Stir It Up Café in Buchanan A to quantitatively determine how many users utilized the 3D displays to inform their sorting decision, found that only 44 out of 100 users actually utilized the 3D displays to inform their sorting decision (Fu et al., 2016). These findings provide interesting insight into the findings presented in this study, as the positive results may only be representative of the users who belong to the group of 44% of people that look at the 3D displays.

The qualitative observation of users checking inside the bins before disposing of their waste item(s) is congruent with the results of the study by Chung et al. (2011) that suggests users will check bin contents to inform their sorting decisions. This user habit of checking bin contents can pose problems because if waste items are sorted incorrectly, the effects can be compounded as users may continue to rely on the incorrect sorting decisions made by previous users.

The positive findings in this study contrast with the inconclusive results of the study conducted by Zelenika (see "Background") (Ivana Zelenika, personal communication, 2016). It is possible that this study had positive results because there was a very narrow scope with a limited number of specific items being observed. It could be possible that when the results are

not item specific (for example, only the overall contamination of the bin is considered), the results could vary, and potentially mirror the results of Zelenika's research (Ivana Zelenika, personal communication, 2016).

Limitations

The timeline of this study poses a limitation in extrapolating the results as the baseline and secondary assessments were only conducted between 10:15am-1pm on Tuesdays in February, March, and April. It was also determined that the environment around the station with the cases may not have been conducive to the use of the cases because the area was very well lit (causing issues with the reflectiveness of the glass), which may have affected the visibility of the cases. One limitation to the use of observations as a data collection method is that it can be difficult to see exactly what items users are disposing of. For example, if the station became crowded with people disposing their waste items it would be difficult to see what items were being disposed of, and into which stream. The cases themselves also have limitations; certain items (see "Methods") were too large to fit in the cases, so although they were initially included in the observation chart, the data collected for those items had to be disregarded. Although this study was conducted in the field, there were still experimental constraints that would not exist in a "real-world" situation. For example, in this study, regardless of whether the napkins and pizza plates were clean or dirty, they were considered the same, and should have been sorted into the compost stream; however, in reality, clean napkins and pizza plates are acceptable in the paper stream. The observation chart was limited by the inability to reflect users' choices when they have multiple items to dispose of. For example, a user may sort multiple items into the incorrect

bins or a combination of correct and incorrect bins. This information could be valuable in determining if certain items in combination cause more confusion than the items individually.

Recommendations

Further Research

A future study should include assessments on more than one day of the week and for longer periods of time during the day; for example, different days of the week, opening to closing hours of the outlets, or lunch and dinner rushes. Another study should look at different items being sold within the Nest or should use different Sort-It-Out stations to generate higher sample sizes for other items. It would also be valuable to assess the effectiveness of an intervention at the time of sorting. It is recommended that the visibility of the cases be considered in future studies; a white backdrop in the case or a solid wall could address this. Although food scraps were not included in the cases for this study, including waxed food scraps in the cases might improve sorting behavior; and therefore, should be considered for future studies. The qualitative observation portion of this study lacked quantitative data about the users and their behaviours (for example, how many people looked into the bins for guidance or how many people did not look at the 3D display cases); future studies may want to include a record of this type of data.

Implementation

The 3D display cases that have been installed on the Sort-It-Out station by Pie-R Squared should remain installed for use in future studies. It is clear that the 3D display cases have a positive effect on the sorting behaviours of bin users, thus the continued installation of 3D

displays on more stations throughout the Nest is recommended. If more 3D display cases are going to be installed, it is recommended that the design be reconsidered as the current cases are inflexible and fragile, which makes them undesirable for long term use in a high traffic building, such as the Nest.

Conclusion

This study provides insight into the benefits of 3D display cases on the sorting behaviours of people using multi-bin waste stations. The results of this study can be extrapolated to all waste stations in the Nest and in other buildings across UBC campus and can inform decisions about the signage on sorting stations in these buildings in the future.

References

About The Nest. (n.d.). Retrieved April 17, 2016, from http://www.ams.ubc.ca/nest/aboutthenest/

AMS Sustainability. (2014). The AMS Lighter Footprint Strategy. Retrieved April 15, 2016, from http://amssustainability.ca/the-ams-lighter-footprint-strategy/

Chung, E., Gaw, F., Guarino, M., & Parnes, D. (2011, April 30). *Waste Sorting System.* Environment, Technology & Society. Retrieved April15, 2016, from http://hackfest.cmubi.org/past-versions-of-this-class/environment-technology-society/2011-accomplishments/wastesortingsystem

Easing the Disposal Dilemma in the Husky Den. (n.d.). Retrieved April 15, 2016, from http://green.uw.edu/promote/snapshots/easing-disposal-dilemma-husky-den

Fu, A., Siu, A., & Misra, R. (2016). *The Effectiveness of 3D Displays on Sorting Behaviour in Post-Secondary Institutions.* Unpublished report.

Johnson, J. (2013, June 21). *Final Report: Husky Den Waste Bin Signage* (Rep.). Retrieved April 15, 2016, from UW Garbology Project website: http://uwgarbology.weebly.com/uploads/1/3/0/1/13017489/husky_den_signage_analysis_v1.0.pdf

Resources. (n.d.). Retrieved April 15, 2016, from https://sustain.ubc.ca/campus-initiatives/recycling-waste/sort-it-out/resources

Sort It Out. (n.d.). Retrieved April 15, 2016, from UBC Sustainability website: https://sustain.ubc.ca/campus-initiatives/recycling-waste/sort-it-out

UBC Vancouver Campus Zero Waste Action Plan (Rep.). (2014, October 3). Retrieved April 15, 2016, from UBC Sustainability website: https://sustain.ubc.ca/sites/sustain.ubc.ca/files/uploads/CampusSustainability/CS_PDFs/RecyclingWaste/Zero_Waste_Action_Plan 2014 10 03 final.pdf

Appendix

Figure 4. Retrieved from https://sustain.ubc.ca/campus-initiatives/recycling-waste/sort-it-out/resources

Figure 5. Retrieved from https://sustain.ubc.ca/campus-initiatives/recycling-waste/sort-it-out/resources

Figure 6. Retrieved from https://sustain.ubc.ca/campus-initiatives/recycling-waste/sort-it-out/resources

Figure 7. Retrieved from https://sustain.ubc.ca/campus-initiatives/recycling-waste/sort-it-out/resources

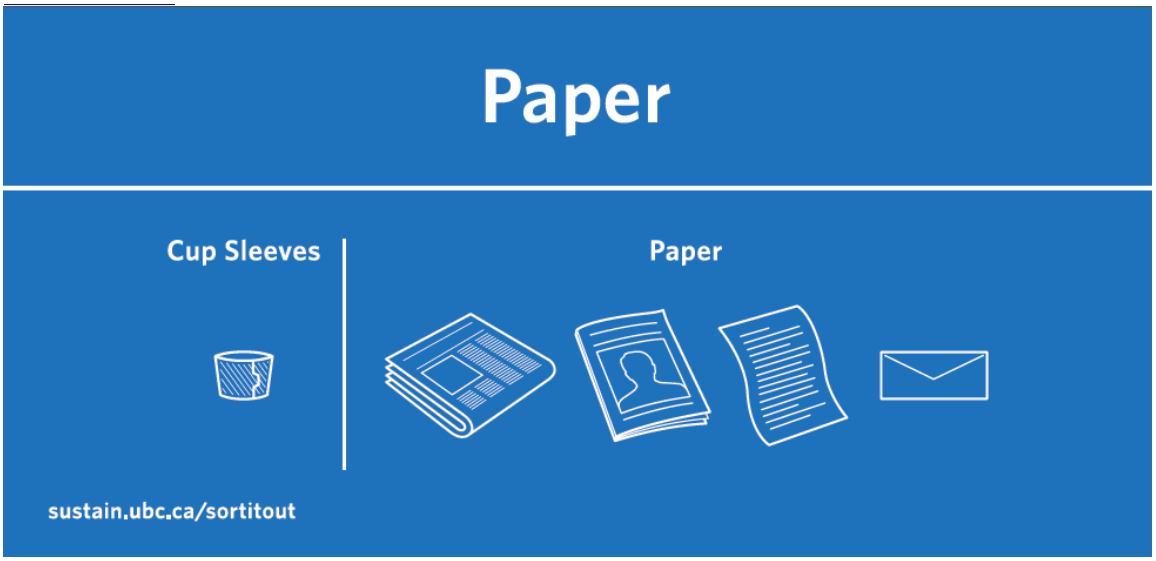


Figure 8.

Figure 9.

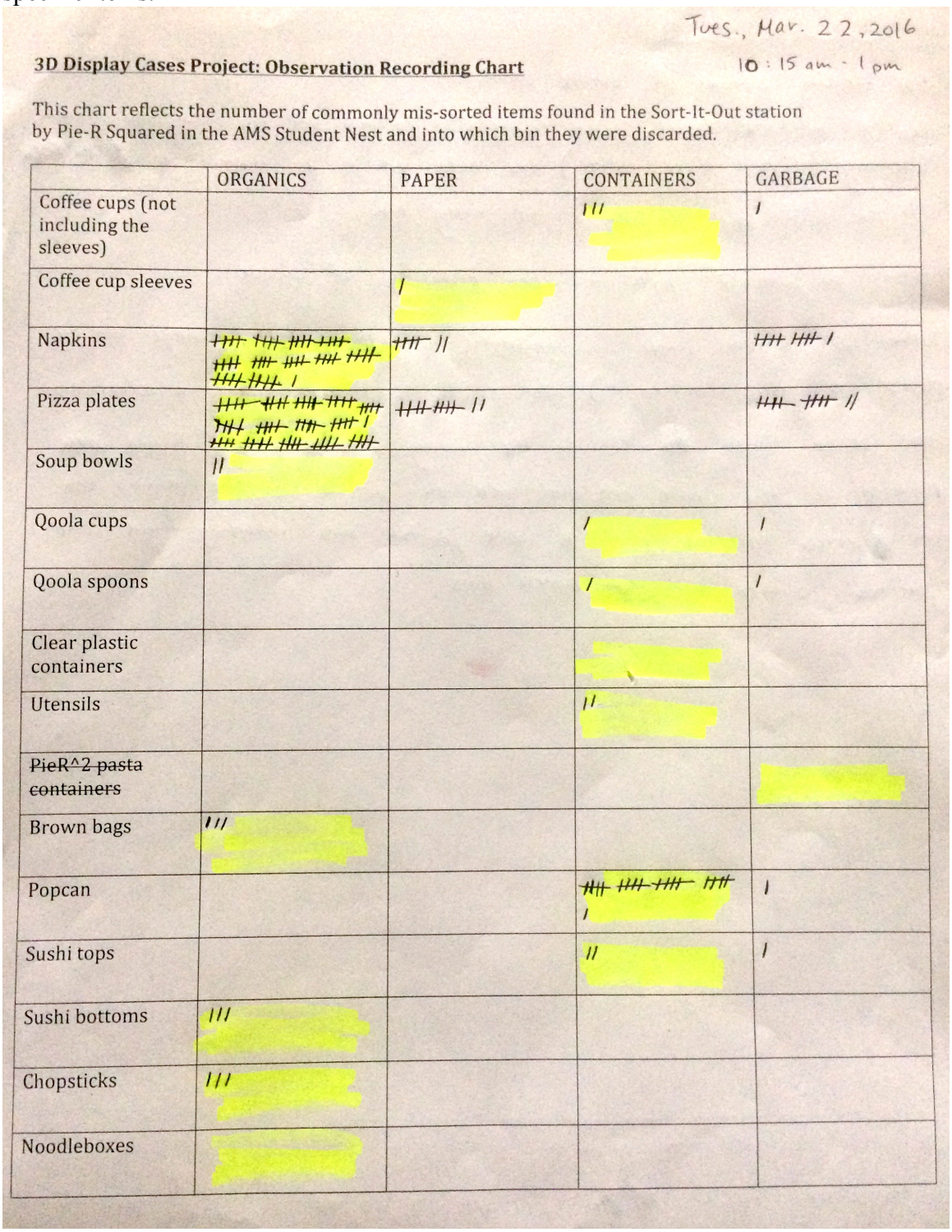
Figure 10.

Figure 11.

Figure 12.


Food Scraps
Recyclable Containers
Paper
Garbage
Is that really garbage?
UBC sustainability
Sort it Out.

Figure 13. Observation chart used to record which waste streams were used to dispose of specific items.



Tues., Mar. 22, 2016

10:15 am - 1 pm

3D Display Cases Project: Observation Recording Chart

This chart reflects the number of commonly mis-sorted items found in the Sort-It-Out station by Pie-R Squared in the AMS Student Nest and into which bin they were discarded.

	ORGANICS	PAPER	CONTAINERS	GARBAGE
Coffee cups (not including the sleeves)			///	/
Coffee cup sleeves		/		
Napkins	𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 /	𝍸 //		𝍸 𝍸 /
Pizza plates	𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 /	𝍸 𝍸 //		𝍸 𝍸 //
Soup bowls	//			
Qoola cups			/	/
Qoola spoons			/	/
Clear plastic containers				
Utensils			//	
~~PieR^2 pasta containers~~				
Brown bags	///			
Popcan			𝍸 𝍸 𝍸 𝍸 /	/
Sushi tops			//	/
Sushi bottoms	///			
Chopsticks	///			
Noodleboxes				

Figure 14. Example of the tables created to show how many of each item was correctly or incorrectly sorted per individual assessment.

Mar. 1st 10:15am-1pm

Item	Correctly Sorted	Incorrectly Sorted
Coffee cups	5	5
Coffee cup sleeves	0	1
Napkins	27	26
Pizza plates	51	33
Soup bowls	1	0
Qoola cups	0	1
Qoola spoons	0	1
Clear plastic containers	0	0
Utensils	2	0
PieR pasta containers	0	0
Brown bags	2	0
Popcan	21	0
Sushi tops	2	4
Sushi bottoms	3	3
Chopsticks	1	5
Noodle boxes	0	0