A Recycling Initiative at Hope College

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Introduction

Everybody creates a huge amount of waste every day. The increase in waste production is about 1.5% a year which is thus a stronger growth than the population rate with 0.97% in 2010 (1). In 2006, the United States generated 251 Million tons of municipal waste with a population of 300 million. That creates more and more problems. Currently most trash is stored on a landfill, so the number and size of landfills is continuously increasing. That also increases the disposal costs for everybody over a long time period. To replace the materials new resources have to be used. The use of new resources costs more energy than the use of recycled materials. The use of recycled Aluminum, for example, needs 90% less energy than the production of new aluminum (2). Recycling helps to reduce the volume of garbage and as a consequence the demand for landfills. Less energy is needed to reuse materials what reduces the Carbon dioxide emissions.

The City of Holland has currently a diversion rate of recyclables from the landfill of 25% and tries to increase the rate up to 50% in the next years (3). Recyclables are stored in yellow plastic bags and picked up with the normal garbage pick up. An average household creates 15-20lbs recyclables per week and 15,000 to 20,000 households are participating in the recycling program (4). So the city of Holland creates 250 – 300 tons of recyclable waste every week that is not going to a landfill.

Hope College provides at least one recycling container for each residence. However, the recycling service has been underused by the students. The students are not well informed about the recycling service and what they can recycle. The aim of this project is

to inform people and to improve the recycling situation in selected dorms by making recycling more convenient.

Methods

In order to gather data for our project, we needed to gather a few materials. We bought bathroom scales for each group member as well as gloves in order to gather data. We obtained our data each week by measuring how much the recyclables weighed by using the bathroom scales. We would stand on a bathroom scale, get our weight, then grab a bag and step back on the scale and get the weight of the group member with the recycling bag. In order to figure out how much each individual bag weighed we would subtract the weight of the individual with the recycling bag with the weight of the individual to gather the data. Each dormitory was weighed on different days of the week because we had to weigh just before the custodial staff came to pick up recycling in order to get the best results. The custodial staff had a set day and time they collected each week. We split up the team to measure different dormitories each day so we would not have one person weighing all of the dorms. Below is a chart showing the dormitories that we used, the number of each people in each dorm, and the treatments we used in each dorm:

Residence	**# Students**	**Average Class Status**	**Treatment**
College East Apartments	114	Junior	Bins, Posters

Scott Hall	95	Freshmen	Posters
Cook Hall	230	Sophomore	Control
Phelps Hall	158	Freshmen	Control

We used Cook and Phelps Halls as our control hall for the experiment so we could compare our data from our treatment to see if there were really changes or not. Scott hall we added advertising posters to see if they would have any effect on the populous.. At College East we added advertising posters and we added small recycling bins to each apartment, one for containers and one for fibers. Containers were plastics and glass, and fibers were paper and cardboard. Instructions were given out to each apartment along with the two bins telling them exactly what they needed to do in order to recycle now. We also added larger recycling bins on each floor so they could deposit their recycling there instead of having to go down to the basement to recycle like they did previous to our experiment. Our experiment lasted nine weeks with five weeks control in all dorms and 4 weeks treatment in Scott and College East.

Results

The recyclables generated in the residences were weighed for 9 weeks. During the first 5 weeks, no treatments were done. Treatments were administered in College East and Scott Hall for the last four weeks. No treatments were administered in Cook Hall or Phelps Hall. When the experiment was complete, all the data were organized in an Excel spreadsheet. The total weight of recyclables from all residences over the entire

experiment was 2,166 lbs. The total amount measured in each residence hall over the entire experiment was also calculated (table 1). The residence with the greatest weight of recyclables measured was College East Apartments. The residence with the smallest weight of recyclables measured was Scott Hall.

The weight per student was calculated and a scatter plot showing the weight per student for each week was generated (fig. 1). For the first 5 weeks, the weight per student fluctuated between 0.20 lbs. per student and 0.60 lbs. per student. At week 6, when the treatments began, the weight of recyclables per student in College East jumped to approximately 1.20 lbs. per student. The rest of the Halls stayed within the range of the first 5 weeks.

The data were imported into Systat and the mean weights per student for the treatments were calculated (fig. 2). In College East, the mean weight per student for the control period was 0.510 lbs. per student. The mean weight for the treatment was 1.048 lbs. per student. A student's t-test was done. It showed that the two means were statistically significantly different ($t = 3.614$, $df = 3$, $p = 0.018$). In Scott Hall, the mean weight per student for the control period was 0.436 lbs. per student. The mean weight per student for the treatment was 0.465 lbs. per student. A student's t-test showed that these means were not significantly different ($t = 0.175$, $df = 3$, $p = 0.436$).

We also considered the factor that Fall break and Thanksgiving break occurred during the period we sampled. During the weeks that these breaks fell, the number of students on campus dropped. We attempted to correct for this by dividing the weight measured each week by the number of students in the residence and by the number of

days in the week not including the break. However, when we did this, our results became less clear.

To determine if students were sorting recyclables properly, bags of recyclables were randomly selected for sorting. The number of fibers, containers, and pieces of garbage in each bag were counted. The results of a few of these counts are presented in table 2. Students were instructed to sort recyclables into two categories: containers (e.g. plastic, glass, and aluminum containers) and fibers (e.g. paper, cardboard). In general, recyclables were well sorted. Percent of correct recyclables in a bag ranged from 98% to 33%. However, bags with percent of correct recyclables lower than 75% were rarely found. We also observed that virtually no containers had liquid in them. This indicates that the weights of containers measured were only of the containers themselves.

Conclusions

The data collected in the experiment indicates that the treatment administered in College East Apartments was effective. This is supported by statistically significant difference in the mean weights per student. The data also indicates that the treatment administered in Scott Hall was not effective because there was no significant difference in the mean weights per student. From these results, it is apparent that posters alone did not increase recycling by student. However, the combination of bins in rooms, collection bins on each floor, and posters did increase student recycling. This treatment increased recycling by 0.538 lbs. per student. It is important to note that the potential for recycling increase may not be same in all residents. Because each apartment has a kitchen in College East, there may be more materials to recycle. Additional work must be done to determine if the potential increase in recycling is the same in all residences.

The results of this experiment seem reasonable when compared to other data on recycling at Hope College. Hope College's recycling service, Waste Management Inc., records data on the mass of recyclables collected from Hope College. Using this data, we calculated that students recycle an average of 0.88 lbs. per student each week. We also calculated the average weight per student per week during the control period using our data to get 0.39 lbs per student. These calculations show that the results of this experiment are reasonable especially when one considers that the Waste Management's figures also include recycling from academic building.

When considering whether or not implementing a program similar to this one, it is necessary to examine the cost of such a project. The total cost of the bins in this project was $855.50. The cost for fire resistant collection bins was $145 per barrel. The small recycling bins placed in rooms cost $5.75 per bin. Labels for all the bins cost $11.00. We estimate it would cost $24,029 for bins to be placed in a similar arrangement across campus. This calculation was simplified by assuming all enrolled student live on campus, all students live 2 per room, and that fire resistant bins were need in all locations. Because these assumptions might not be valid in every instance, the actual cost of bins may vary. Next, we sought to calculate how much Hope could save by implementing this program. Waste Management's current rate for servicing a 2 yd^3 trash container is $61.75 per month and $35.29 per month to service the same sized container of recyclables. Last year, Hope recycled 44.954 lbs. of material. If we assume that recycling increases by 0.538 lbs. per student per week and that addition weight of recyclables reduces the weight of garbage by the same amount, Hope could save $11,260 per year. At that rate, the

saving would pay for the bins after 2.1 years. Considering the potential savings, implementing this program across Hope College would be a savings.

In addition to the monetary savings, the environment would also benefit from increased recycling. Last year, Hope College saved 459 trees, or 267,476 gal. of water, or 100 metric tons of carbon from being emitted into atmosphere by recycling (Waste Management Inc., 2010). By implementing a program that maximizes convenience over a larger area, such as the City of Holland, the environmental benefits would be even greater. It would also help Holland reach its goal of achieving a 50% diversion rate of recyclables within the next few years.

From this experiment it is clear that maximizing convenience increases the amount students recycle. By placing bins in rooms, collection bins on each floor, and posters in that same residence, recycling by students increased. Posters alone did not increase the amount students recycled. It is also clear that implementing this program across campus would be feasible and would save Hope money. The environmental benefits of such a program would also be significant. These findings not only apply to Hope College, but can apply to other colleges or universities as well as municipalities. This study also raises addition questions. These include what component of the treatment had the greatest influence on recycling, do all residences respond the same way to this treatment, and how can this be applied to larger municipalities? Despite these unanswered questions, it is now clear that increasing convenience increases the amount students recycle.

https://www.cia.gov/library/publications/the-world-factbook/geos/us.html

http://www.cleanair.org/Waste/wasteFacts.html

Mary Ann Hensley, City of Holland

Sean Steele, founder and owner of “Chef Container”

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