

DALHOUSIE UNIVERSITY

Student Cell Phone Usage and Disposal

ENVS 3502: Winter 2014

Marley Geddes – Environmental Science
Brynn Roach – Environmental Science & Sustainability
Hilary Saunders – Environmental Science & Sustainability
Tamara Michelle – International Development & Sustainability
Andrew Simpson – International Development & Sustainability
Nick Von Buttlar – Earth Sciences & Sustainability
Jamie Smith – Management

4/7/2014

Contents

- 1. Executive Summary 1
- 2. Introduction 2
 - 2.1 Background 2
 - 2.2 Rationale 2
 - 2.3 Purpose and Report Outline 2
 - 2.4 Goals and Objectives..... 3
- 3. Methods..... 3
 - 3.1 Research Methods 3
 - 3.2 Sampling Methods 4
 - 3.2.1 Sampling Frame and Size 4
 - 3.2.2 Sampling Procedure 4
 - 3.3 Reliability and Validity..... 5
 - 3.4 Limitations and Delimitations 5
 - 3.5 Data Analysis..... 6
- 4. Results 6
- 5. Discussion..... 10
- 6. Conclusion..... 11
- Acknowledgements..... 11
- References..... 12
- Appendix A: Survey 14
- Appendix B: Ethics Proposal- Project Description 16
- Appendix C: Ethics Proposal - Informed Consent 23

List of Figures

- Figure 1. Pie graph showing percentages of phones that Dalhousie students on the Studley campus have replaced in the last three years. Data was gathered in March 2014 and include 145 student responses.....7
- Figure 2. Bar graph showing the state of replaced cell phones of surveyed students on the Dalhousie Studley campus (non-functioning or functioning). Data was gathered in March 2014 and include 145 student responses.....8
- Figure 3. Pie graph showing the disposal method of replaced cell phones of surveyed Dalhousie students on the Studley campus. Data was gathered in March 2014 and include 145 student responses.....9
- Figure 4. Bar graph showing student support in donating still functioning and non-functioning cell phones to a reuse program on campus. Data was gathered in March 2014 and include 145 student responses.....9

1. Executive Summary

Electronic waste is a rapidly growing issue that has troubling environmental and social implications for our society. Specifically, electronic waste contains toxic substances that are detrimental to the environment and human health if electronic items are not properly managed and disposed of. The rate of technological advances and hyper-consumerism in society, coupled with improper recycling practices are the root causes of electronic waste. Electronics are becoming obsolete at a faster rate because of the accessibility of new and updated technological breakthroughs. This phenomenon is especially true with cell phones, which have relatively short lifecycles and are generally replaced by many users within a year after their initial purchase (Ongondo & Williams, 2011). Dalhousie University is an excellent place to examine electronic waste. With a large student base that both purchase and use electronics and a well-known university wide commitment to sustainability, this study aims to assess student's cellphone usage behavior and disposal methods and whether they are sustainable on campus. The primary goal of the study is to examine the phenomenon of cell phone usage and the disposal methods of current Dalhousie students on Studley campus, as well as determining if these methods are sustainable. A sub-goal of this study is to quantify student support for a cell phone reuse program on campus.

Using a self-administered survey (see Appendix A), we were able to determine that Dalhousie Student cell phone usage behavior and disposal methods are not sustainable. Our survey found that 61% of students polled have replaced their cell phones two or more times within the last three years and 95 % of polled students have replaced them at least once within the last three years. The majority of these phones were replaced while still functioning (functioning is defined in this survey as: still being able to text and call). In combination with that statistic, we found that 54% of polled students keep their old phones, instead of recycling and 9% of students have thrown them in the garbage. According to our survey, most students do not know how to properly dispose of their used cell phones. We suggest the development of a cell phone re-use program through the University which would help solve this sustainability issue. Students could donate their still functioning phones to the re-use program where they could be made available to others. This program could also be used as a recycling program where any non-functional phones could be properly disposed of to eliminate electronic waste. Our study found that students would strongly support a reuse program; 92% of students would be willing to donate their old, still functioning cell phones to a reuse program and 97% of students would donate their non-functioning phones to be disposed of properly. Our suggestion is that this program could be implemented through the Office of Sustainability and/or Dalhousie Facilities Management and would become an important facet of strengthening Dalhousie's commitment to sustainability.

2. Introduction

2.1 Background

As technology continues to become important and improves at an exceptional rate, the electronic waste (E-waste) left over from the constant technological updates and new products leaves alarming environmental and social implications. As we update our technology, we do not update the policies needed to control and manage its waste impact. The current global E-waste production is estimated to be between 20 and 25 million tonnes per year and is overwhelmingly produced by developed countries (Robinson, 2009). E-waste contains over 1000 different materials, some of which are harmful to the environment and human health when disposed of improperly in garbage or landfills (Widmer et al, 2005). These hazardous materials include, but are not limited to, polychlorinated biphenyls (PCBs), chlorofluorocarbon (CFCs), and metals such as lead, mercury, cadmium and Rare Earth elements (REE) (ewasteguide.info, 2009). When E-waste is disposed of improperly, it can release contaminants into the surrounding environment and causes massive environmental degradation. Many of the materials in E-waste, such as PCBs, are bio-accumulating (i.e. accumulate in fatty tissues within the human body). This can have serious negative effects on fetal development and the ongoing nursing infants as well as to higher level predators who live off the compromised and polluted environment. (Xing et al, 2009; McDonald and Tomko, 2013). For example, lead is present in a lot of products and if it is improperly disposed of leads to lead poisoning which causes damage to the central and peripheral nervous system, blood systems and kidneys in humans (Huo et al, 2007). Cadmium, a known carcinogen, can leach from E-waste into shallow groundwater which can have serious health implications for those who live in close proximity and use the water (Wu et al, 2014). The environmental and human health impacts of E-waste are still not fully understood but, even with what we do know so far about E-waste, it is a global health issue and research needs to be focused towards furthering our understanding of both the effect and causes of this issue.

2.2 Rationale

Advanced technology and hyper-consumerism are supporting factor in the phenomenon of unsustainable cell phone use. Consumers are opting to replace still functional cell phones when newer designs and technologies become available. This, coupled with the environmental and health impacts of E-waste that happen through improper cell phone disposal, provides rationale for our study to assess cell phone usage and disposal methods of Dalhousie students. A similar study was conducted by Ongondo and Williams to assess the behaviour of students with regards to their cell phone use and disposal methods. Using a large scale survey of students at five UK universities, they found that many students replace their phones once a year and that almost 60% of replaced cell phones are not sent to an electronic waste recycling facility or reuse program, but are kept by the students. There has not been a comprehensive study similar to that of Ongondo's and Williams' at Dalhousie University. We addressed this gap in the literature by conducting our own smaller study to provide a similar assessment of student cell phone usage and disposal methods, focusing on the Studley campus (see sampling frame and size, pg. 5).

2.3 Purpose and Report Outline

The purpose of this research is to analyse patterns in cell-phone usage and the disposal methods of the students on Studley campus. We have conducted this study with the objective of greening the campus by targeting the pressing issue of E-waste. Our research is explanatory in that it will explore the current cell phone usage and waste disposal methods of students at Dalhousie. Are research question is: are Dalhousie student usage and cell phone disposal

methods sustainable? We hypothesize that Dalhousie student cell phone usage and disposal methods are unsustainable. Our final report is a detailed account of all aspects that were covered during our three month research frame. Firstly, the report includes an overview of the purpose, objectives, and reasoning behind the research. Secondly, we have detailed the methods used to collect the data including reasoning behind sampling procedures, and measures of analysis. Thirdly, our report presents the final results and our findings. Finally, the report closes with suggestions for action and further research. Through conducting this project, we have gained a more thorough understanding of the issue of cell phone use and disposal methods of Dalhousie students. We have identified future measures that could be taken to address this issue and how to work towards increasing sustainability on campus.

2.4 Goals and Objectives

This study provides a baseline understanding of cell phone usage patterns and corresponding waste disposal methods of Dalhousie students on the Studley campus. This is the first study at Dalhousie focused on cell phone use and disposal methods specifically, although similar studies regarding electronic waste at Dalhousie have been conducted in the past (Gezelius, Childs, Hristow, Williams, & Wilson, 2012). Our primary goal is to establish a baseline understanding of student behaviour regarding cell phone usage behavior and disposal and identify if these behaviors and methods are sustainable. Our sub-goal is to empower future students to conduct further research into the issue of E-waste and unsustainable cell behaviors. In the long term, future students have the potential to explore the issue and encourage individual and collective action through empowerment. We believe that education is an important part of creating social change. The project will be accessible to the public and thus has the potential to increase the understanding and empowerment of students across the campus. Within our study, we have quantified student opinion and overall support in creating a cell phone reuse program in the future at Dalhousie. We hope that this information will be used in decision-making processes regarding the possible development of a reuse program by the Office of Sustainability and/or Dalhousie Facilities Management.

3. Methods

3.1 Research Methods

To make the most accurate assessment, we believe it is important to get information about student cell phone usage and disposal methods directly from the students. We used quantitative research methods with an explanatory approach. A self-administered survey was our main data collection tool. Surveys are a relatively inexpensive way to collect a large amount of information in a short amount of time (Jackson, 1999, p.99). We used a survey as our main research tool because we were limited by both a time constraints and access to money. We did not have the resources to conduct face-to-face interviews with a large enough number of subjects. We self-administered our survey because making personal contact with the participants results in a better rate of responses which is important for the accuracy and validity of data (Jackson, 1999).

We constructed our survey with seven questions which accurately measure student's cell phone usage, as well as the disposal methods of replaced cell phone (see Appendix A). We designed the survey to take each participant approximately a minute to complete. The first question provided information on whether the participant is a Dalhousie student whose faculty is located on the Studley Campus; those participants who were not in our sampling frame (e.g.

faculty, students from other campuses; see sampling methods section) were excluded from our study (their surveys were shredded).

Our survey only has three spots available for subjects to fill out information on replaced cell phones (i.e. 3ii, 4ii, 5ii); this posed an issue for students who have replaced more than three cell phones in the last three years. We decided not to include more than three options because keeping survey short and simple is an important aspect for respondent participation (Jackson, 1999). Despite this trade-off, we believe that our survey was accurate in answering our questions. By asking details about the used cell phones that were replaced, we were able to determine if cell phones are being replaced while they are still functional (i.e. 3i, 4i, 5i) and what students were doing with replaced cell phones (i.e. 3ii, 4ii 5ii). Functional is defined as can text and call – this was included as a definition for participants on the survey.

3.2 Sampling Methods

3.2.1 Sampling Frame and Size

The population we are interested in is the Dalhousie student population; but, because of limited time and money, we have narrowed our sampling frame to the student population at the Studley Campus, Dalhousie's largest campus (Dalhousie, 2014).

After email correspondence with Dalhousie registrar's office and data requests regarding student population data for the Studley campus, we were informed that Dalhousie does not have population data for the Studley campus (Dennis, Dalhousie Data Requests, Personal communications, February 21, 2014). After contacting our mentor, our group has made an assumption that the Studley Campus has approximately 10,000 students, because it is the largest Dalhousie campus (Dalhousie, 2014). We used the Raosoft Sample Size Calculator to determine a sample size that would be significant enough to make inference on the entire Studley Campus population; 370 was our goal sample size (95% confidence level, 5% margin of error; Raosoft Inc., 2013). Unfortunately due to limited time and student interest, we were only able to sample 145 students (7.95% margin of error; Raosoft Inc., 2013). Although a smaller sample size does not allow as accurate of inference, we still believe that our sample size is large enough to make valid generalizations to the Studley population (Van Wilgenburg, 2014).

3.2.2 Sampling Procedure

We used probabilistic sampling as our sampling method, it was assumed, all students at the Studley Campus have an equal chance of being selected to participate in our survey (Van Wilgenburg, 2014). We used two different locations for sampling: the atrium of the Killam library and the Student Union Building (SUB). Although we had first planned to just sample in the Atrium, it became evident with low participation rate and student interest, that it was necessary to include another location to increase our sample size. We choose the atrium of the Killam and SUB because both locations are on the Studley Campus thus, it was assumed the majority of the students at these locations would fall within our sampling frame. All group members participated in administering the surveys. We administered our survey on several days (19th, 20th and 24th of March), with at least two members of our group located at each location (Killam atrium and SUB). Based on the presence of several restaurants within both the Killam Atrium and the SUB, we decided to sample between the hours of 12pm and 3pm because, we assumed, most students would be at these locations for lunch. Incentives are a commonly used in surveys to encourage potential subjects to participate. We chose to use an incentive, Swiss Delice chocolates, to encourage students to participate in our survey. The chocolates were bought previous to the survey from Costco by a member of the group. Several members of the group tasted the chocolates to ensure that they were safe for consumption. We had first

planned to sit at a table and allow students to approach us if they wanted to participate in our survey. We quickly realised that the incentives alone were not enough to attract the attention of the students and we decided to use the intercept method (Jackson, 1999). This survey administering procedure involved a member of our group approaching another person (or group of people) and asking if they would like to participate in a study on cell phone use and disposal methods by filling out a short, one minute survey; students were then offered a chocolate. All group members realised the ethical importance in ensuring that all students were aware that their participation is strictly voluntary and that they may, at any time, withdraw from the survey (Kirby et al, 2010). We were sure to keep our distance to ensure that participants did not feel pressured. Following completion of the survey we thanked the students for their participation and elaborated on our research for those who were interested and inquired.

3.3 Reliability and Validity

Reliability reflects this question: “can we get the same results again?”(Kriby et al, 2010, p. 242). Our study is not 100% reliable because not all students within our sampling frame participated. Student responses will vary among individuals and there is no guarantee that students will answer each question truthfully therefore, in repeating this study, it will be unlikely that the exact same data will be gathered. We are assuming that, because of our relatively large sample size (145 students), our findings are representative of the Studley Campus student population. Several different techniques were used in ensuring validity in that our survey properly measured cell phone usage and disposal methods. Before applying for ethics approval, we asked several friends, and students to review our survey questions and give feedback on the wording of the questions. Through this method we were able to ensure that the questions were clearly worded and easily understood. Members of the group were stationed nearby after administering the survey in case participants had any questions, so that they could have them answered directly.

3.4 Limitations and Delimitations

A major limitation for this study was time. The class that this project was completed for (ENVS 3502) is a one semester class, which meant that there was a definitive 4 month timeline to complete the project . We aimed to sample all of Dalhousie students, but were forced to narrow our scope to students at the Studley Campus. Collecting a representative sample of students on every campus of Dalhousie would have been too difficult with our time constraint. Another limitation was the participation of individuals who did not fall into our sampling frame. Despite our attempts to minimize the number of non-sampling frame individuals surveyed (e.g. surveying on the Studley campus, high student traffic areas), we administered 15 surveys to individuals who did not meet our sampling frame criteria (e.g were not students and/or faculty was not on Studley campus). It is important when analyzing and making conclusions from the data that we remember the delimitations of our survey. The narrow scope of this study is a major delimitation. With limited time, it was unrealistic to sample a representative amount of all Dalhousie students, thus we narrowed our scope to the Studley Campus. This makes inference to the Dalhousie student population as a whole less valid.

3.5 Data Analysis

We developed a coding system which we entered into Microsoft Excel. The coding system consists of simple integers which code for particular answers within our survey (Palys & Atchinson, 2008). This allows the data to be easily analysed. The following is a breakdown of how each type of question was coded (see Appendix A to view the survey):

1. Question 1: Surveys which indicated that the individual was not within our sampling frame (indicated by circling no to question 1) were not used in the survey.
2. Question 2: A coding system was not used for question 2 asking how many cell phones the participant has acquired in the past 3 years. The actual number of cell phones was used.
3. Questions with yes/no responses (questions 3i, 4i, 5i, 6 and 7): Yes questions were coded with a 1 and no questions were coded with a 0.
4. Questions asking to indicate how replaced phones were disposed of (questions 3ii, 4ii, 5ii): Answers were coded 1-5 .

The coding method allowed us to analyse how many participants answered each question thus enabling us to make conclusions about cell phone usage and disposal methods of the students we surveyed and make inference on those trends on the Studley campus.

4. Results

In order to fully understand the phenomenon of cell phone use and disposal methods of students at Dalhousie and quantify student support of a cell phone reuse program on campus, the behaviour of students had to be identified. A self-administered survey of students on Studley campus was selected as a research tool to gather information on several aspects of cell phone usage and disposal methods. Our sample size was originally 160 but 15 were removed from analysis because the subject did not fall within our sampling frame (see sampling frame and size section, pg. 5). Therefore, 145 surveys were analysed.

Question 2 of the survey asked participants to indicate how many cell phones they have acquired in the past 3 years (see Appendix A). We found the average number of phones acquired was 1.88 per student in the last three years. Figure 1 depicts the percentage of students which replaced 0, 1, 2 and 3 or more cell phones in the last three years.

Number of Phones Replaced in Last Three Years

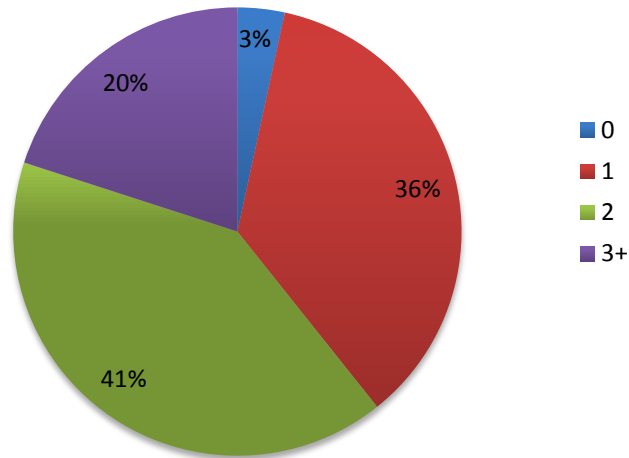


Figure 1. Pie graph showing percentages of phones that Dalhousie students on the Studley campus have replaced in the last three years. Data was gathered in March 2014 and include 145 student responses.

Students were asked about the state of the cell phones replaced in questions 3 i. 4 i. and 5 i. (state of first, second and third phone replaced) and were given two options to choose from: non-functioning and functioning (functioning was defined as the phone can still text and call within the survey). The three questions were first analysed individually, and after finding no significant difference between the responses, they were grouped together to be analysed (see figure 2).

Replaced Cell Phone Status

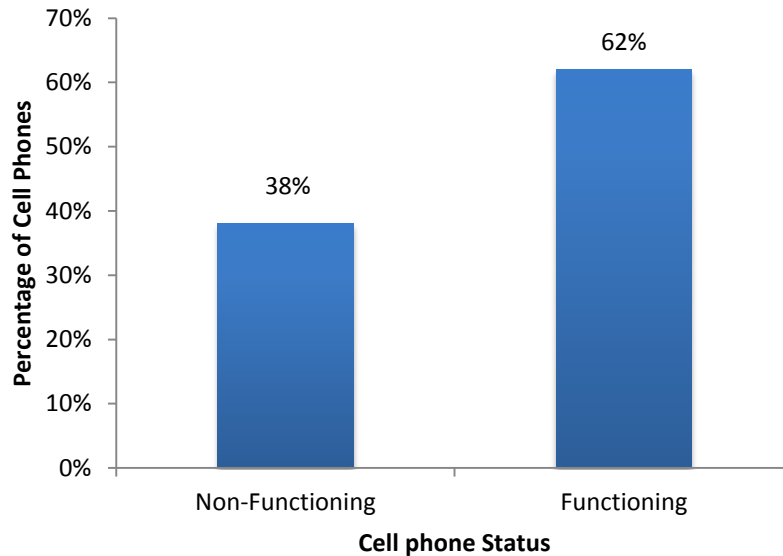


Figure 2. Bar graph showing the state of replaced cell phones of surveyed students on the Dalhousie Studley campus (non-functioning or functioning). Data was gathered in March 2014 and include 145 student responses.

Questions 3 ii. 4ii. and 5 ii. of the survey address how students first, second and third cell phones were replaced, respectively. Similarly to part one of questions 3, 4 and 5, we analysed these questions separately and compared them. We found there was no significant difference and the responses were grouped and analysed collectively. Students were asked to indicate how they disposed of their replaced cell phones and were given 5 options to choose from:

1. I throw them in the garbage
2. I keep them, I don't know what to do with them
3. I take them to the nearest e-waste recycling facility
4. I give them away to be re-used
5. other, if so explain _____

The percent of students that have used each of these disposal methods are visually represented in figure 3.

Disposal Methods

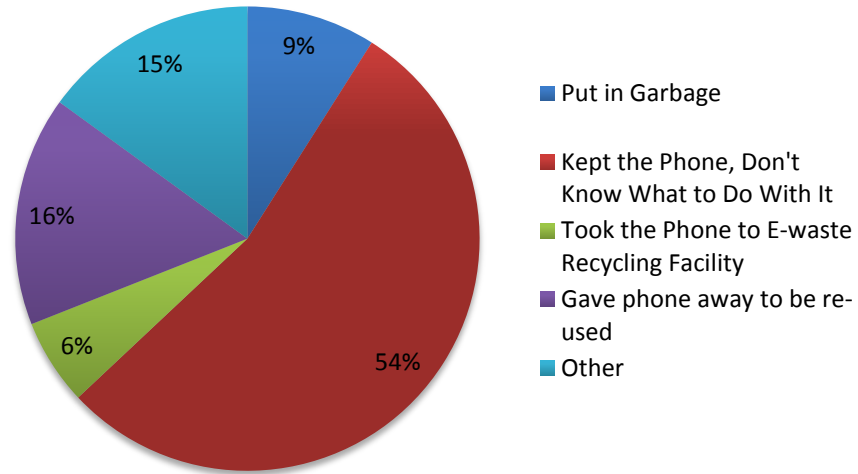


Figure 3. Pie graph showing the disposal method of replaced cell phones of surveyed Dalhousie students on the Studley campus. Data was gathered in March 2014 and include 145 student responses.

Our survey concluded with two questions regarding student support for a re-use program on campus, if one were available. Question 6 asked students if they would be interested in a donating their old, still functioning cell-phone(s) to a reuse program on campus, if one were made available. Question 7 asked students if they would be willing to drop off their non-functioning phone(s) on campus to be taken to a recycling facility. Student support for a re-use program on campus is visually represented in figure 4.

Support for Reuse Program

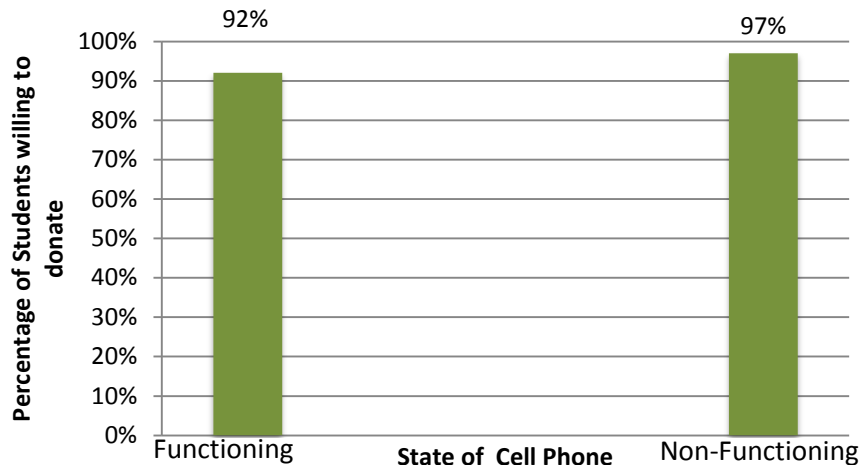


Figure 4. Bar graph showing student support in donating still functioning and non-functioning cell phones to a reuse program on campus. Data was gathered in March 2014 and include 145 student responses.

5. Discussion

Technological advances and hyper consumerism in the electronic market has led to a quick turnover rate of cell phones. This is not sustainable as the number of phones becoming obsolete are contributing to the global issue of E-waste which, when improperly recycled or disposed of, can lead to serious environmental and human health concerns. The results of our study show that Dalhousie students' cell phone usage behavior and disposal methods are unsustainable and thus are contributing to the phenomenon of E-waste. Our study finds that 97% of students have replaced their phone at least once within the last three years with the majority (41%) having replaced two phones. The majority (62%) of phones are replaced while they are still functional (can call and text) (see results section page 7). Many students are replacing still functioning cell phones with newer versions with more advanced technologies or designs and thus finding their old phones obsolete.

Dalhousie student cell phone usage behavior is not sustainable. Dalhousie students' cell phone disposal methods are contributing to the growing issue of E-waste as the majority of students are not participating in proper cell phone recycling or disposal methods. Our findings are consistent with Ongondo's and Williams' (2011) in that students cell phone use and disposal methods of students are unsustainable. Only 22% of students dispose of their used cell phones sustainably (16% give old phones away to be reused, 6% take it to a proper E-waste facility) and 63% did not follow sustainable e-waste disposal methods (9% putting them in the garbage, 54% kept the phone). The remaining 15% of students disposed of their used phones in alternative ways, with most of these students admitting they had lost the phone. When phones are thrown in the garbage, they are often transported to a landfill where they are likely to leach dangerous chemicals (e.g. mercury, Lead, and cadmium)(ewasteguide.info, 2009) into the surrounding environment.

The plan of disposal for 54% of old phones accounted for by individual students is unknown, although our study finds that almost all students would support more sustainable options if they were available on campus. We found 92% of students would be willing to donate old, still functioning cell phones to a reuse program and that 97% would donate their non-functioning phones to be properly disposed of (see figure 4). These results highlight the important notion that, although students want to partake in more sustainable behaviours on campus regarding cell phone disposal, there are no current programs available to support this demand.

This study provides only baseline information on student cell phone usage and disposal methods and was conducted to assess if cell phone usage and disposal is sustainable. We suggest that future research goes deeper into the issue, focusing on the root causes or supporting factors involved in unsustainable cell phone use and disposal. Trends and relationships between cell phone usage and disposal methods should be identified considering different variables including, but not limited to, demographics (e.g. gender, age) and faculty (e.g. sciences, arts); this will allow for a better understanding of the usage and disposal rates for Dalhousie students and allow for easier implementation of a plan to fix for more sustainable action on campus.

6. Conclusion

Through our research, data collection, and analysis, we have concluded that cell phone usage and disposal is currently not sustainable among Dalhousie University students on Studley campus. Both functional and non-functional cell phones are being replaced at a rapid rate among students to keep up with the constant technological shift while there is no clear method of disposal available on campus. Since improper disposal of electronics can have a negative environmental impact and only 22% of our survey participants sustainably disposed of their phones, there is considerable room for improvement in creating sustainable cell phone disposal on Studley campus and the university as a whole (see figure 3). Additionally, through our research, we have learned that Dalhousie students are unanimously in favor of using a cell phone disposal/ reuse program if there were one available on campus (see figure 4).

We believe that education is the foundation of social change and therefore should play an important role in raising awareness about sustainable cell phone usage and disposal. A sustainable cell phone usage and disposal program run or funded by the Faculty of Sustainability or Dalhousie Facilities Management would be an instrumental tool in achieving sustainability on campus. Without a larger organization or funding, sustainability surrounding cells phones usage and disposal on campus will likely not change. E-waste is a fundamental problem that affects our environment and our society, but through education, discourse and active planning, Dalhousie could become a great role model for an active sustainable society and could send their students into society armed with sustainable knowledge and practices for the future.

Acknowledgements

We would like to thank Dr. Hendricus Van Wilgenburg for educating us on the concepts necessary to complete this study. We would also like to thank Tim Cashion for providing us with advice and support through the challenges and setbacks we encountered. Lastly, we would like to thank Jess Geddes who provided editing services.

References

- Bhuie, A. e. (2004). Environmental and Economic Trade-Offs in Consumer Electronic Products Recycling: A case study of cell phones and computers . *Institute of Electrical and Electronics Engineers*, 74-79.
- Cui, J. a. (2008). Metallurgical recovery of metals from electronic waste: A review. *Journal of Hazardous Materials*, 228-256. Retrieved from http://ac.els-cdn.com/S0304389408002161/1-s2.0-S0304389408002161-main.pdf?_tid=217a22f8-b4fa-11e3-a64a-00000aab0f02&acdnat=1395847394_63f2e52c310c9e2cabbb2747b3d5fe22
- Environmental Protection Agency (2014). Mercury Health Effects. *United States Environmental Protection Agency*. Retrieved from <http://www.epa.gov/hg/effects.htm>
- E-waste Guide. (2009). Hazardous Substances in e-Waste. *E-waste guide*. Retrieved from http://ewasteguide.info/hazardous_substances
- Gezelius M., Childs A., Hristow C., Williams H., & Wilson M. (2012). E-Waste and Battery Recycling at Dalhousie University. *ENVS 3502 Final Report*. Retrieved from <http://www.dal.ca/faculty/science/environmental-science-program/research/envs-3502---past-projects/2012.html>
- Huo, X., Peng, L., Xu, X., Zheng, L., Qiu, B., Qi, Z., Zhang, B., ... Piao, Z. (January 01, 2007). Elevated blood lead levels of children in Guiyu, an electronic waste recycling town in China. *Environmental Health Perspectives*, 115, 7, 1113-7.
- McDonald, K. M. (2013). Environmental fate of hexabromocyclododecane from a new Canadian electronic recycling facility. *Journal of Environmental Management*, 324-327. doi:10.1016
- Ongondo, F. O., & Williams, I. D. (2011). Greening academia: Use and disposal of mobile phones among university students. *Waste Management*, 31(7), 1617-1634. doi:<http://dx.doi.org.ezproxy.library.dal.ca/10.1016/j.wasman.2011.01.031>
- Palys, T. & Atchinson, C. (2008) *Research Decisions: Quantitative and qualitative perspectives*. Toronto: Nelson.
- Raosoft Inc. (2004). *Sample Size Calculator*. Retrieved from <http://www.raosoft.com/samplesize.html>
- Van Wilgenburg, H. (2014). *Elements of a Method Section*. Retrieved from https://dalhousie.blackboard.com/webapps/portal/frameset.jsp?tab_group=courses&url=%2Fwebapps%2Fblackboard%2Fexecute%2Fcontent%2Ffile%3Fcmd%3Dview%26content_id%3D_550391_1%26course_id%3D_16191_1%26framesetWrapped%3Dtrue

- Widmer, R., Oswald-Krapf, H., Sinha-Khetriwal, D., Schnellmann, M., & Böni, H. (2005). Global perspectives on e-waste. *Environmental Impact Assessment Review*, 25(5), 436-458. doi:<http://dx.doi.org.ezproxy.library.dal.ca/10.1016/j.eiar.2005.04.001>
- Wu, C., Luo, Y., Deng, S., Teng, Y., & Song, J. (2014). Spatial characteristics of cadmium in topsoils in a typical e-waste recycling area in southeast china and its potential threat to shallow groundwater. *Science of the Total Environment*, 472(0), 556-561. doi:<http://dx.doi.org.ezproxy.library.dal.ca/10.1016/j.scitotenv.2013.11.084>
- Xing, G., Chan, J., Leung, A., Wu, S., & Wong, M. (2009). Environmental impact and human exposure to PCBs in Guiyu, an electronic waste recycling site in China. *Environment International*, 35, 1, 76-82.

Appendix A: Survey

Hi! We are students in ENVS 3502: Environmental Problem Solving II. We are conducting this survey to gather information on the cell phone usage and disposal methods of students on the Studley campus. We also want to gauge student willingness to participate in a cell phone reuse program if one were implemented on campus. We need your help to quantify student cell phone usage and disposal methods! This survey is anonymous and, with your permission, will be used as data for our project.

If you have any questions or concerns regarding the survey or our project, please contact Dr. Hendricus Van Wilgenburg (hwilgenb@dal.ca), professor of ENVS 3502.

Thank you for your time, we appreciate it!

By circling yes, I consent to having my answers used as data for this project: Yes No
(if neither are circled, or no is circled, then this survey will be disregarded)

1) Are you a Dalhousie student whose faculty is on the Studley campus? (circle yes or no):

Yes

No

2). How many new cell phones have you acquired in the past 3 years? We are defining new as an unused cell phone (please check that which applies):

0___ 1___ 2___ 3___ If more than 3 how many? _____

For the following 3 questions we are asking details about the individual cell phones (if any) you have had replaced in the last three years. If you have replaced more than three cell phones then complete the questions about your first three replaced cell phones.

3 i. For your **first** used cell phone you replaced, was it still functioning? We define functioning as can text and call (circle either yes or no):

Yes

No

3 ii. How you dispose of the first phone you replaced? (check the answer that applies to you)

___ I throw them in the garbage

___ I keep them, I don't know what to do with them

___ I take them to the nearest e-waste recycling facility

___ I give them away to be re-used

___ other, if so explain _____

4 i. For your **second** used cell phone you replaced, was it still functioning? We define functioning as can text and call (circle either yes or no):

Yes

No

4. ii. How you dispose of the second phone you replaced? (check the answer that applies to you)

I throw them in the garbage

I keep them, I don't know what to do with them

I take them to the nearest e-waste recycling facility

I give them away to be re-used

other, if so

explain _____

5 i. For your **third** used cell phone you replaced, was it still functioning? We define functioning as can text and call (circle either yes or no):

Yes

No

5 ii. How you dispose of the third phone you replaced? (check the answer that applies to you)

I throw them in the garbage

I keep them, I don't know what to do with them

I take them to the nearest e-waste recycling facility

I give them away to be re-used

other, if so

explain _____

There is currently no program at Dalhousie in which students can donate old used cell phones to be given to members of the community. There are also no programs or facilities at Dalhousie in which provide students a means to properly recycle old non-functioning cell phones.

6). Would you be interested in a donating your old, still functioning cell-phone(s) to a reuse program on campus if one were made available? (circle yes or no):

Yes

No

7). Would you be willing to drop off your non-functioning phone(s) on campus to be taken to a recycling facility? (circle yes or no):

Yes

No

Thank you for your participation

Appendix B: Ethics Proposal- Project Description

2.1 LAY SUMMARY [500 words]

In lay language, briefly describe the rationale, purpose, study population and methods.

Electronic waste (e-waste) is a recently emerging issue that has concerning environmental and social implications. E-waste is detrimental to the environment as it has the potential to cause land degradation and environmental pollution. It is important when looking at the proximate causes and solutions of environmental and social issues such as electronic waste to return to the root of the problem. Many electronic devices are replaced when they are still working and able to perform their main function. We want to look at electronics use and disposal methods of Dalhousie students to gauge whether students were using and disposing of their electronics sustainably. Due to limited time we decided that it would be difficult to assess all electronic devices, therefore, we narrowed our focus to looking at cell phone usage and disposal methods by Dalhousie students.

The purpose of our research study is to identify whether Dalhousie students are disposing of their cell phones while they are still functional. We are defining functional as having the ability to successfully call and text. We also intend on quantifying student willingness to participate in a cell phone reuse program on campus. Although there is no current cell phone reuse program at Dalhousie, our project will gather data about the support for such a program. The target population of our research is the Dalhousie student population. Due to time and money constraints, we have narrowed our sampling frame to the student population at the Dalhousie's largest campus, Studley Campus.

We propose using quantitative research methods with an explanatory approach. The research tool we propose to use is a self-administered survey. We have developed a list of survey questions that we believe will accurately measure student cell phone usage and disposal methods for each cell phone that was replaced. We are hoping that the survey will provide a significant amount of data to further our understanding and make inferences about cell phone usage and disposal methods of Dalhousie students on the Studley Campus (see our proposed survey in Appendix I). We are using a survey because it is a quick and easy way to gather a large amount of data; because we are both limited by time and money, it is important that our research tool has these qualities. We designed the survey to take approximately one minute, as shorter surveys generally have higher participation. This survey will be self-administered at our proposed location of the atrium of the Killam library, an area on the Studley campus that has high student traffic (read more about our sampling methods within the sections below).

2.2 RESEARCH QUESTION

State the hypotheses, the research questions or research objectives.

The research question that will help us to better understand the phenomenon of cell phone use by students on Dalhousie campus is what is the current cell phone usage of students at Dalhousie University and how are students used cell phones being disposed of (note that we narrowed our sampling frame to Dalhousie students of the Studley campus)?

Our research hypothesis is as follows: Dalhousie students, on the Studley campus, are replacing their cell phones while they are still functional. We are defining functional as still able to text and call.

The objective of the study is to gain an understanding of student cell phone usage and disposal methods amongst the student population on the Studley campus. The study will also gauge student willingness to participate in a cell phone reuse program on campus, if one were implemented.

2.3 RECRUITMENT

2.3.1 Describe how many participants are needed and how this was determined.

We aim to include 370 participants in our study. After consultation with our course mentor, we used the Raosoft Sample Size Calculator to determine a sample size that would be significant enough to make inference on the entire Studley Campus population (95% confidence level, 5% margin of error).

2.3.2 Describe recruitment plans and append recruitment instruments. Describe who will be doing the recruitment and what actions they will take, including any screening procedures. Describe any inclusion / exclusion criteria.

We propose to use a self-administered survey. This study will be a joint effort by all members of our group. Our plan is to set up a table in the atrium of the Killam Library, which students can approach; the approach ensures that there is no pressure placed on the potential respondents and that they feel free to refuse participation. Participation in our study is completely voluntary. Due to our large sample size, it will likely be necessary to administer this survey for several days; two to three students will be present on each day.

We will have incentives for students to participate in the study. Candy will be available for those

who participate in the study. We will have a poster (on bristol board) to attract the students' attention. The poster will include the name of our study and explain that they can receive free candy for a moment of their time (see appendix III for a pictorial representation of the poster).

Our sampling frame is limited to students on the Studley campus. To ensure only include surveys completed by Dalhousie students on the Studley campus (e.g., no staff, faculty, students from other campuses or non-students) the first question of our survey will ask "Are you a Dalhousie student whose faculty is on the Studley campus? (circle yes or no)". Surveys that indicate that they are non-Dalhousie students from the Studley campus will be excluded from the study.

2.4 METHODS AND ANALYSIS

2.4.1 Discuss where the research will be conducted, what participants will be asked to do and the time commitment, what data will be recorded using what research instruments (append copies). Discuss any blinding or randomization measures. Discuss how participants will be given the opportunity to withdraw.

Our research tool is a self-administered survey (see Appendix I for the proposed survey). We plan to set up a table in the atrium of the Killam library, which students can approach if they wish to participate; this ensures that there is no pressure placed on the respondents and that they feel free to refuse participation. The study is completely voluntary. Participants will be asked to complete the survey, which we designed to take approximately a minute to complete. There will be no blinding or randomization measures taken. We will not approach students to ask them to participate in our survey because we did not want them to feel pressured in any way. Two or three group members will be sitting at a table where we will have surveys and candy available. Students interested in participating in our study can approach the table. Group members will verbally explain that the survey is voluntary and that students can withdraw from the survey at any point.

2.4.2 Describe your role in this research and any special qualifications you have that are relevant to this study (e.g. professional experience, methods courses, fieldwork experience).

All group members are third or fourth year students in ENVS 3502: Environmental Problem Solving II, hence our experience in studies similar to this is limited. We have read a lot of literature focused on research methods. This literature has provided us guidelines and tips on developing good survey questions and how to properly administer surveys. The ENVS 3502 and course mentor

provide us with valuable advice and guidance.

2.4.3 Describe plans for data analysis in relation to the hypotheses/questions/objectives.

We intend to input the survey data into a statistical software program, such as Minitab or Excel. We will be using a coding system where each answer will be represented as a number. We will be able to analyze how many students chose each number and see if there are relationships or trends within the data. Assuming we will reach the intended sample size (370 subjects), we will be able to make inferences about cell phone usage and disposal methods of all students on the Studley Campus. We will also be able to quantify the percentage of student interest in a reuse program at Dalhousie.

2.4.4 Describe and justify any use of deception or nondisclosure and explain how participants will be debriefed.

Deception will not take place in this study.

Not applicable

2.4.5 Describe any compensation, reimbursement or incentives that will be given to participants (including those who withdraw).

We will have candy incentives that we will provide to the participants to encourage them to participate in the survey. This will be available even to those who fill out the survey and circle 'no' to question 1, indicating that they are not Dalhousie students whose faculty is on the Studley campus.

Not applicable

2.5 INFORMED CONSENT PROCESS

Describe the informed consent process (i.e. how and when the research will be described to the prospective participant and by whom, how the researcher will ensure the prospective participant is fully informed of what they will be asked to do). If non-written consent is proposed, describe why

and the process. If a waiver of informed consent is sought, address the criteria in the guidance document and TCPS articles 3.7 and/or 5.5. Address how any third party consent (with or without assent) will be managed. Describe any plans for ongoing consent, and/or community consent. Discuss how participants will be given the opportunity to withdraw (their participation and/or their data, and any limitations on this).

Append copies of all consent forms or any oral consent script.

A short oral informed consent script will be given to each potential respondent before they participate in the survey. The purpose of this script is to inform the participant about our study, what class it is for (ENVS 3502) and the goal of our survey. Participation in our study is completely voluntary and participants are encouraged to voice any questions or concerns regarding our project or survey. We have included a section within the survey that asks the participants' permission to use the data collected. The participants have the option to circle 'yes' (to consent) or 'no' (not giving consent). Participants who do not consent or do not circle 'yes' or 'no' will not be included in our study.

2.6 PRIVACY & CONFIDENTIALITY

2.6.1 Describe how data will be stored and handled in a secure manner, how long data will be retained and where, and plans for its destruction.

After the completion of the survey, data will be inputted into excel. The survey will then be destroyed (using a paper shredder) and recycled. The data input should be completed within a day following the completion of the survey. After the analysis and interpretation of the data is complete and the project is complete, the excel sheet will be deleted.

2.6.2 Address any limits on confidentiality, such as a duty to disclose abuse or neglect of a child or adult in need of protection, and how these will be handled. Such limits should be described in consent documents.

Not applicable

Not applicable

2.6.3 Does your use of any survey company or software to help you collect, manage, store, or analyze data mean that personally identifiable information is accessible from outside of Canada?

→NO No

Yes. If yes, describe your use of the company or software and describe how you comply with the University *Policy for the Protection of Personal Information from Access Outside Canada*.

2.6.4 Describe the measures to be undertaken for dissemination of research results and whether participants will be identified (either directly by name or indirectly). If participants will be quoted in reports from the data, address consent for this, including whether quotes will be identifiable or attributed. Describe how participants will be informed of results that may indicate they may be at risk (in screening or data collection), if applicable.

Participants will not be identified in our survey. We will not be taking or including quotes or names of participants in our project. The results of our research will be communicated verbally to the students and staff of Dalhousie in a concise, short Pecha Kucha presentation. The findings of the project will also be represented in a course-based report that will be made available on the Dalhousie website following the years completion. The website address is:

<http://www.dal.ca/faculty/science/environmental-science-program/research/envs-3502---past-projects.html>

2.7 RISK & BENEFIT ANALYSIS

2.7.1 Discuss what risks or discomforts are anticipated for participants, how likely risks are and how risks will be mitigated.

The survey does not involve risks or discomforts to the participants. Our questions were designed with the participants in mind and we believe that questions will not bring about any discomforts or affect the participants negatively. We are not approaching students directly, so they feel comfortable about (and not pressured) participating in our study. Instead, we will be setting up a

table in a welcoming manner so that students feel comfortable to approach us, inquire about the study, and participate if they wish.

2.7.2 Identify any direct benefits of participation to participants (other than compensation), and the indirect benefits of the study (e.g. contribution to new knowledge)

The participants will have the option to have a candy when they participate in the study. Possible indirect benefits are that participants may become more self-awareness when it comes to their cell phone usage and disposal habits.

2.8 CONFLICT OF INTEREST

Describe whether any conflict of interest exists for any member of the research team in relation to potential research participants (e.g., TA, fellow students), and/or study sponsors, and how this will be handled.

Not applicable

Not applicable

Appendix C: Ethics Proposal - Informed Consent



Informed Consent

Date: Tuesday February 25th, 2014

Study Name: Cell phone usage and disposal

Researchers: Brynn Roach, Marley Geddes, Jamie Smith, Tamara Freeman, Nick von Buttlar, Andrew Simpson, Hilary Saunders

This research will be used for a course-based project in ENVS/SUST 3502 at Dalhousie University. The professor for the course is Dr. Hendricus Van Wilgenburg - hwilgenb@dal.ca

Purpose of the Research: You are invited to take part in this research study. The purpose of this study is to quantify cell phone usage amongst the student population and gain an understanding of cell phone disposal methods. Your participation is completely voluntary.

What You Will Be Asked to Do in the Research: You will be asked to participate in a survey that will take approximately 1 to 3 minutes to complete. Your participation in this study is completely voluntary and you can withdraw from the study at any time.

Risks and Discomforts: We do not foresee any risks or discomfort to you from your participation in this research. If you experience any discomforts with eating the candy offered, you are under no obligation to consume it. We can assure you that the candy is safe to consume, if you so choose. The was purchased from Wal-Mart. Remember that your participation is completely voluntary and that you can withdraw from the study at any time, if you feel uncomfortable or that you are at risk, without penalty.

Benefits of the Research and Benefits to You: In contributing to our research you will help to address the over-arching issue of electronic waste. Furthermore, you are contributing to the 'greening' of Dalhousie campus. You may benefit directly, if the findings encourage the Office of Sustainability or Waste Management (or other groups) to implement a cell phone reuse program on campus.

Voluntary Participation: Your participation in the study is completely voluntary and you may withdraw from the study at any time. In addition, you are free to refuse to answer any question in the survey.

Withdrawal from the Study: You are free to withdraw from the study at any time, for any reason, if you so decide. If you decide to withdraw, you will still be eligible to receive the promised pay (candy) for agreeing to be in the project. Your decision to withdraw, or to refuse to answer particular questions, will not affect your relationship with the researchers, Dalhousie University, or any other group associated with this project. In the event you withdraw from the study, if you wish, all associated data collected will be immediately destroyed wherever possible.

Confidentiality: All information you supply during the research will be held in confidence and unless you specifically indicate your consent, your name will not appear in any report or publication of the research. The survey results will be inserted in a software program for analysis (e.g. Microsoft Excel). Your data will be safely stored in a computerized file and only research staff and the course instructor will have access to this information. The data will be stored for the duration of the project and destroyed of after the study. Confidentiality will be provided to the fullest extent possible.

Questions About the Research? If you have questions about the research in general or about your role in the study, please feel free to contact Dr. Hendricus A. Van Wilgenburg either by telephone at (902) 678-3844, or by e-mail hwilgenb@dal.ca. This research has been reviewed and approved by the Dalhousie University's Environmental Science Program Ethics Review Committee and conforms to the standards of the Canadian Tri-Council Research Ethics guidelines. If you have any questions about this process, or about your rights as a participant in the study, please contact Research Ethics, Dalhousie Research Services, 5th Henry Hicks Building, Rm 231, Dalhousie University, PO Box 15000, Halifax, Nova Scotia B3H 4R2 (telephone 1.902.494.3423 or e-mail ethics@dal.ca).