ACCESS Tech Student Reuse Event: Understanding Student Motivation & Experience in Upcycling Technology

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Abstract

Upcycling is the sustainable practice of refurbishing or repurposing used material (Wegener, 2016). McMaster University tackles sustainability by offering students the opportunity to upcycle technology at the ACCESS Tech Student Reuse Event. The goal of this study was to gather student accounts of the intrinsic motivations and experiences at this event. As a group of student researchers, we interviewed 21 students at the time of the event and conducted a qualitative thematic analysis on the transcript data collected from the interviews. For motivation, we identified themes of free technology, environment, community, and curiosity. For student experience, we identified themes of positive experience, simple process, excited for future use/challenges, and areas for improvement. Future recommendations include sending out questionnaires prior to the ACCESS Tech Student Reuse Event regarding inventory, increasing social media activity to improve marketing and community engagement, and booking a bigger room in a different McMaster University building to improve student experience. Further studies are encouraged to be conducted regarding financial benefits, technology reuse, and student perceptions of the event.

Introduction

Consider the various items within our household and how we interact with them. Items typically found in the household include clothing, furniture, and technology. They all serve their individual purpose, but what happens when they reach the end of their expected life? What happens when outdated technology is replaced by *newer* technology? Electronic devices and other such items are improving at an increasing rate, alongside their normalization within our society. When newer technology is advertised with quality-of-life changes, the older models are discarded and become incapable of adapting and competing with the trends, resulting in electronic waste, otherwise known as e-waste. The technology industry inherently follows a linear economic model, that is to use resources, make and advertise a product, then dispose of it once it has been used (Reuter et al, 2018).

Impacts of E-waste on Health & Environment

As a result of this linear model, the amount of e-waste grows more within our environment, which poses multiple negative environmental and health impacts in society. One of the largest environmental impacts comes from the disposal of e-waste, resulting in the oversaturation of toxic chemicals within water bodies; one such example can be found in Guiyu, China where the content of lead in the Lijiang river was found to be between 1.9-24 mg/L, which is multitudes greater than the World Health Organization's allowable lead content of 0.01 mg/L (Sivaramanan, 2013). This is considered a negative environmental impact as it results in the river becoming unsanitary, limiting any opportunity to grow crops or harvest fish (Sivaramanan, 2013). Furthermore, the exposure to hazardous chemicals like lead within e-waste can cause various health complications. These hazardous chemicals are seen to have carcinogenic effects, which negatively impact neurodevelopment, reproductive development, and pose both intellectual and attention difficulties (Perkins et al, 2014).

Upcycling as a Method of E-waste Management

Traditional e-waste management methods include landfill disposal and incineration, which pose significant environmental and health risks as outlined in previous sections (Kiddee et al, 2013). Although considered traditional and common in both developed and developing countries, it is important to acknowledge that these methods are not sustainable in the long term. Given that e-waste is a rapidly growing issue, it is important to consider long-term sustainable practices, such as transitioning from a linear economy into a circular economy. In the context of this research paper, we will consider upcycling as a form of sustainable e-waste management. Upcycling takes on the combined concepts of upgrading and recycling, with a focus on reusing materials and adding value to that item. This practice aims to establish value in novelty and creativity through the reuse of material. It is also a practice related to greener living, with the aim to reduce the need to dispose of material by recycling components (Wegener, 2016). Upcycling as a form of sustainable e-waste management takes on the concept of the three Rs, that is to reduce, reuse, and recycle. The three Rs follow the idea of environmental stewardship as a way of teaching society the fundamentals of tackling environmental issues, such as how to produce less waste, how to reuse material before disposal, and if all else fails, how to recycle safely (MacDonald, 2020). By reusing and upcycling materials, the need for recycling is reduced, ensuring that other materials and resources are preserved in the process (Wegener, 2016).

Existing Research about the Student Perception on Upcycling

Current research conducted on student motivations and experiences on upcycling technology have various factors and limitations. One such limitation is that the scope of other studies attempts to project their findings on a global scale based on the results conducted locally. Furthermore, the research goals of other studies tend to focus on the incorporation of upcycling through education about the benefits of upcycling. For example, a research study conducted in Ukraine by Ya V. Shuhailo detailed how students within a Ukrainian design and technology program incorporated upcycling within their daily life based on their initial perceptions and experiences on upcycling. The students were surveyed and categorized based on how often they practice upcycling techniques; results showed large differences in activity levels of upcycling based on their existing motivations and knowledge. Students who regularly practiced upcycling did so due to their pre-existing understanding of its environmental and financial benefits. Conversely, students who very rarely practiced upcycling displayed a lack of knowledge on the benefits of upcycling (Shuhailo et al. 2022). While this study offers some insight on motivations behind upcycling, it did not place too much emphasis on student experiences and instead focused on determining solutions about how to better incorporate upcycling within their lives. Another research paper conducted by a university located in the Midwest of the United States of America had similar methods to our research. Jim Flowers and others offered an elective course regarding material life cycle and environmental responsibility in three consecutive years from 2015, open to any student from all levels of education. These students initially noted how they did not practice upcycling due to their understanding of the time and energy costs, believing that the benefits did not outweigh those costs. However, after completing various course projects, Flowers noticed a positive shift in student perception on upcycling; most students realized that upcycling was a low-cost, easy practice with a broad selection of materials. These changing perceptions were noted through feedback taken during the course and were used to determine other effective methods to

introduce upcycling as a method of e-waste management (Flowers et al. 2018). While this bears some similarities in methods to our own research, this research was conducted over the course of multiple years through an optional course offering. Additionally, the methods in the previous research papers involved influencing the perception on upcycling of a set group of students over a period of time. In comparison, the scope of our research and data collection process was limited to a single day and to a brief window of time to interview student participants at the event. Although the study of student perception and motivations on upcycling is not entirely new, we believe that the novelty of interviewing university students at a technology upcycling event is inherently unique. Our research focuses not only on understanding student motivations behind upcycling, but we also focus on the student experience and how to improve the event on a local scale to make a larger impact.

Brief Overview of the Study Context

Sustainable practices have been an integral part of McMaster University's history as early as 2001, with an event called *Dump and Run* by the McMaster Student Union Environmental Committee to decrease the amount of student waste during move-out (Thomson, 2004). In 2009, with the advent of McMaster's Office of Sustainability, McMaster implemented sustainable technology initiatives (McMaster University, 2022). The new Office of Sustainability and Department of Facility Services aimed to collect outdated technological devices to ensure that up to 90% of components were diverted from landfill disposal (Palka, 2009). In 2012/2013, McMaster developed the Academic Sustainability Programs Office, which established multiple 'SUSTAIN' courses for students who had a shared passion for a greener future and to take leadership in environmental projects and research. In 2018/2019 a group of students pursued a project to pilot the *Trash to Treasure* initiative as part of *SUSTAIN 3S03 - Implementing Sustainable Change*, aimed to refurbish and donate used computers to children in need (Kuang, 2020). Through collaborations with the Department of Facility Services, Department of University Technology Services, community partners, and McMaster students within the SUSTAIN Program, the ACCESS Tech Initiative was established to better fit the context of the pandemic (Nietresta et al., 2021).

The ACCESS Tech initiative involved reimagining McMaster's collection, reuse, and donation process for e-waste. The ACCESS Tech Drive is a collaborative event between McMaster students and staff, Empowerment Squared, and network agencies, whose goal is to gather used computers, laptops, or mobile devices to donate to Hamiltonians in need. For those items not suitable for community donation, the ACCESS Tech Student Reuse Event makes remaining collected devices available for students to take for free on campus to further minimize e-waste (Facility Services, 2021).

Through our course, *SUSTAIN 4S06 – Leadership in Sustainability*, we took the opportunity to learn about the ACCESS Tech Initiative, we were able to pursue our project goal of advocating to continually enhance the initiative and improve the student experience. Thus, we took the opportunity to pursue this goal at the ACCESS Tech Student Reuse Event at McMaster University to first understand the underlying motivation of students attending the event and their overall experience. This research paper will further expand in detail the methodological approach we employed, the prevalent themes identified, and the results of our data analysis. The results and

discussion portion will highlight the importance of upcycling and e-waste management as well as suggestions and recommendations that can further enhance future upcycling events.

Methods

Overview

For this study, our research team wanted to understand the student motivations and experiences behind upcycling technology from the ACCESS Tech Student Reuse Events at McMaster University. Following the approval from McMaster's Research Ethics Board (#6001), our research team attended the ACCESS Tech Student Reuse Event in September 2022. For our research, we followed Braun & Clarke's (2006) approach to qualitative thematic analysis, which is described in the subsections below.

The ACCESS Tech Student Reuse Event took place on September 29, 2022, from 10:00am to 4:00pm. The event was held on the second floor of the Gerald Hatch Centre at McMaster University. Donated technology was set out by volunteers across two large rooms and was organized by category. At the entrance to the event space, the ACCESS Tech team had a sign-in table for people to check in before entering. Students began lining up around 9:30am in the general lobby space outside the rooms. As students entered the event, they were informed that they could take up to three pieces of free technology. Extra technology was kept in separate rooms to be brought out in waves throughout the event to replace the technology that had already been taken. Our research team had a table set up in the lobby space to talk to student attendees about our research study and to conduct interviews. By utilizing in-person interviews to collect our data, this allowed us to engage with students directly after they experienced the event.

Recruitment

At the event, participants were recruited to be interviewed as they exited the event space. After having been through the event and collected technology, these students then had an opportunity to share their motivations and experiences with our researchers. All participants consented to the conditions for the research, which includes reporting their data anonymously. To avoid ethical conflicts, participants were recruited at random and if a participant was known to a member of the research team, then another member of the team conducted that interview to avoid potential biases.

Data Collection

Interviews took place at the event and students received a $10 CAD gift card to Starbucks upon agreeing to participate. Among the 253 students who participated in the event, 21 students took part in a semi-structured, in-person interview. Core questions that we posed to our participants are outlined below and follow-up questions were asked by the interviewer, where necessary, to gather additional details or clarification.

1. What brought you to this event?
2. Was there anything you didn't find today?
3. What are you planning to do with these items?

4. Why is this event valuable to you?
5. Is there anything that we missed that you would like to add?

Of the 21 participants, 20 agreed to have their interview audio recorded and the remaining participant had their interview recorded by hand. Interviews were later transcribed manually, with punctuation added to facilitate the analysis process and clarity of the text to best reflect the original audio. The original audio recordings were deleted after the transcription process to maintain confidentiality.

Through this process, we wanted to avoid directing participants towards a certain response and collect data with a diverse range of answers. While developing our interview questions, we ensured that the questions were posed as open-ended to provide an opportunity for participants to give more in-depth responses. By using this style of question, participants had the freedom to interpret the question and express opinions that we as researchers may not have previously considered. As interviewers, this also allowed us to ask follow-up questions where necessary to better understand the response given and the meaning behind it. This interview style provided us with detailed and relevant data to include in this report.

Thematic Analysis

Thematic analysis took place from October 2022 to January 2023. The process for thematic analysis closely followed methods of Braun and Clarke (2006). To follow an inductive approach, literature was not consulted during this stage to avoid bias and influence from external sources during the thematic analysis process. After the interviews were transcribed, the formal coding process began. Through continuous review of our codes and sub-codes, we became familiar with the data, making it easier to understand the underlying meaning of the participants' ideas. When coding our data, we used our research question and initial codes to derive key themes. If an idea was prevalent across the data set, appearing in at least six interviews, then it was considered a theme. Each data item was coded by colour and number. This allowed us to easily search for quotes that correlated with each theme. During the coding stage, we noticed a distinction between themes related to student motivations behind upcycling technology and themes related to student experiences of upcycling technology. As a result, the key themes were split into two categories: motivations and experiences.

Using thematic mapping, we displayed the key themes for each of these categories. Numerous iterations of the thematic maps were made before finalizing four key themes for each category (see thematic map iterations in Appendix A). These maps aided in reviewing the themes and refining their names. With limited research previously done on this topic, our analysis of these key themes provides a rich description of the entire data set.

Since this is new exploratory research, we wanted to ensure that the key themes are an accurate reflection of the entire data set. Using a semantic approach, the themes were identified within an explicit or surface level meaning of the data, tied to the language participants used in their interviews. At this stage of analysis, a certain level of interpretation was required to understand the meaning or context of a participant’s idea. An essentialist/realist epistemological approach was adopted “to theorize experiences, motivations, and meaning" from the interviews in a simple, straightforward way (Braun and Clarke, 2006, pg. 85). During the final phase of thematic analysis, producing the report, our team aimed to relate our findings back to the research question

and build connections between themes. A literature review was conducted to help give context to the importance of this issue and develop the connections between key themes. Quotes were extracted from the interview transcriptions to demonstrate the prevalence of the seven key themes (see Results section for more detail). The process of qualitative thematic analysis has led to a rich representation of the results drawn from the 21 interviews and helped us demonstrate the value of the ACCESS Tech Student Reuse Events from a student perspective.

Results

As the study outcome, we evaluated students' motivations and experiences behind upcycling technology from McMaster's ACCESS Tech Student Reuse Event. Since our research goal focused on both 'motivations' and 'experiences', we structured our data analysis around these two categories. These two main categories were further expanded after analyzing the transcribed and coded data, where seven subcategories were summarized in the thematic map below.

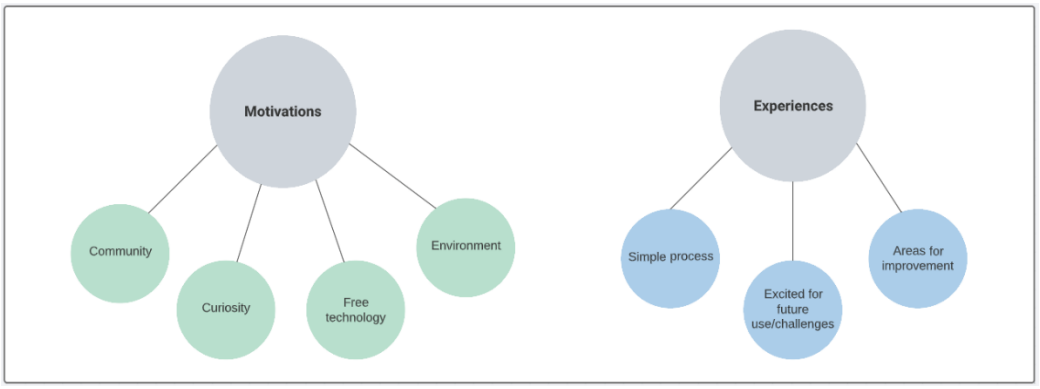

Figure 1. Final thematic map of the qualitative thematic analysis.

Student Motivation

Understanding what motivated students can help us to understand why events such as ACCESS Tech Student Reuse Event were essential and beneficial to the student demographic. After exploring the intrinsic motivations from the coded data, we categorized the responses that motivated students to participate in the event into four key themes, curiosity, free technology, environment, and community.

Curiosity

One of the prominent motivations was curiosity. Curiosity was chosen as a key theme because nine of the 21 collected interviews reported that they were curious to see what type of electronics were available for upcycling and to explore the value of the older technology. Additionally, 19 interviewees came in looking for specific items, and only two mentioned they came in to browse. When asked about their reasoning for upcycling an old computer, one student commented, "...The old computer I honestly want to see if I can run my old sims game on it, it's a CD but I'm like interested in electronics, playing around with it and something maybe I can learn from it and potentially use some of its parts for my courses too, so that might be really cool to see". While in other interviews, students constantly expressed how they came in "to see if" and "to find if" certain electronics could work the way they planned. This behavior clearly demonstrated

genuine curiosity towards the electronics offered at the upcycling event. Therefore, students' curiosity to come to the event and upcycle old electronics was one of their most prominent motivators.

Free Technology

Free and accessible technology has been one of the primary motivators for students participating in the event. Financial accessibility was found to be the most common and prevalent motivator. From the coded interviews, financial accessibility was mentioned 19 times. The ACCESS Tech event was an event that was free of charge and most students mentioned this when asked what brought them to the event during the interview. In one of the interviews, a student shared their thoughts on the event, "You don't get a lot of opportunities to get free tech stuff. As students, we don't have the money to go out and get technology stuff so having an event where we can get it for free is amazing". This demonstrated that university students have different financial backgrounds with varying levels of financial security; students with less security who require technology can benefit from events like ACCESS Tech event to acquire technology free of charge. In fact, advertising free technologies from the event was so powerful that it attracted students regardless of financial backgrounds, which made it one of the key motivators.

Environmental Sustainability

Participants wanting to help the environment was another key theme. Students were incentivized in upcycling technology due to the environmental benefits of reusing items before disposing of them. When asked about the value of the upcycling event, one student said, "[i]t was a great way to be environmentally friendly. Rather than throwing out all these amazing stuff to waste, we can reuse them and make the most out of them." Similar responses were recorded multiple times from different interviews, where the general consensus was "upcycling prevented electronics waste which was good for the environment". This simple and intuitive consensus demonstrated that being able to reduce e-waste going to landfills was important to students.

Community Involvement

Many students came to the upcycling event wanting to get involved with the McMaster community, as well as to find others with common interests. There were six interviews that mentioned community, such that one commented, "I've met some cool people here today that I plan on keeping in touch with. Hopefully, they will teach me the ropes on how to use all this used technology and maybe for the next one, you will see me picking apart some of these devices too." Other than attending the event purely for upcycling purpose, many people also attended to show support to the McMaster student community and meet people with similar interest. Something also to note was that about half of attendees came as a group of two or more; There were a lot of conversations with neighboring groups which showed community involvement.

Student Experience

The results of this study also helped us to understand the student experience further when upcycling technology. Our study investigated how the student demographic perceived the ACCESS Tech Student Reuse Event in terms of accessibility, their future uses of the technology they found, and their suggestions for future events. These results allowed us to formulate suggestions for future ACCESS Tech Student Reuse Events to improve student experience while also evaluating the overall health and reputation of the ACCESS Tech Student Reuse Event. Three key themes were summarized under the experience category, including simple process, excitement for the future/challenge, and areas for improvement.

Simple Process

"Simple process" referred to the overall logistics of the event, where most participants described it as simple and efficient. Out of the 21 interviews conducted, there were six mentions related to the physical location/accessibility of the event. People generally commented on the speed of the lineup, how the location was easy or difficult to find, and other aspects on the process of the upcycling event. One interviewee described the event in quote, "I think the event is well run, the line looked long but it moved really fast that was impressive that you guys did that. Also, spreading the technology to different rooms I think was helpful while making sure there wasn't too congested in one room". While there were negative experiences such as "slow lineup" and "difficult to find specific item", most students shared positive feedback especially mentioning simple process when asked what they think of the event.

Future Use/Challenges

Future usage and challenges can be summarized as looking forward to exploring old technology for different purposes. Some electronics may need to be repaired, but some saw it as a potential challenge. When asking about the students' plans and excitement regarding the new technology they retrieved at the event, the most prevalent responses involved school and personal use. Work was only mentioned by two interviewees, while school and personal use were the most prevalent with 18 and 14 mentions respectively. One interviewee's response was quoted, "[y]ea, the laptop we are going to try to find how we can fix and repurpose it, rather than going to the trash, hopefully we can fix it and use it maybe for school for my sister, or helping my mom with learning technologies, I think that can benefit from it." Since the event catered mostly for the student population, it's fitting that many of the attendees were there to find technology that will benefit their academic performance. There were also several responses that involved students wanting to use the items they got for hobbies and personal projects. To wrap up the overall purposes, we decided to categorize it under future usage/challenges.

Areas for Improvement

From the post-event feedback, student suggestions for future ACCESS Tech Student Reuse Events were collected and summarized under the experience category. Suggestions regarding inventory were the most prevalent, with a total of 13 interviewees mentioned; event promotion and physical space were also common as they were mentioned by five and eight interviewees respectively. One of the students suggested, "I think better marketing for the future so that more

people can participate, and more people can reap the benefits of this great program." Other recommendations also included sorting items based off sections and labelling them, as well as housing the upcycling event at another area on campus. As almost all participants concluded the interview with a recommendation, this made area for improvement one of the key themes under experience category.

Key Findings

The results from this study have provided key evidence that was used to support our research goals through thematic analysis and thematic mapping. Through our analysis, we identified that the main motivators of student participating in the upcycling event were free technology, curiosity towards the event and use of technology, wanting to contribute to environmental sustainability by reducing e-waste, and getting involved in the McMaster community. Students coming out to the ACCESS Tech Student Reuse Event displayed their support with post-event experiences including simple and efficient logistics, excitement towards future use and challenges, and provided suggestions on areas for improvement.

Discussion

A Unique Student Experience

Based on interview responses along with our own experience, we believe that the student experience at the ACCESS Tech Student Reuse Event is unique compared to other events. The upcycling initiative is part two of the ACCESS Tech Initiative, with part one being the donation Drive that involves participants donating used technology that will get collected by the ACCESS Tech team. The Donation Drive followed a drop-in style as anyone was able to come and drop off used technology without having to line up. The Drive also included the following: volunteers that managed the donated technology, music to create an entertaining atmosphere, and a donut stand to incentivize the donors for their participation. The student experience at the ACCESS Tech Student Reuse Event is unlike the donation event as it had long line-ups, a sign-in process where the event administrators collected personal information, a limit of three items, and no other commodities to incentive student engagement. When comparing both the Drive and Student Reuse events, there is a contrast in style and overall student experience. While donors were recognized and appreciated for their active participation in the Drive, donating versus upcycling requires different skill sets. For example, anyone who can find old electronic items is able to show up to the Drive and drop off their technology without having to know whether the items they donate can be reused. Conversely, students who upcycle require knowledge and expertise in technology to understand the various components that make up old technology in order for them to give used technology a whole new life. Despite several remarks being made regarding the large line-ups, long wait time, and crowded environments, students attending the upcycling drive stayed through the whole process. This portrays their patience, determination, and the passion they have for upcycling technology; which is a unique observation in comparison to the donation initiative. We can further improve the student experience at the ACCESS Tech Student Reuse Event to better align it with how we see and value upcyclers as we do with our donors.

To improve student experience, our first recommendation is to implement a time-slot system where students can sign up and come to the event at specific times. Students who show a

great deal of interest in the event can use this system to avoid long line-ups and wait times; allowing them to attend the event at a convenient time in order to avoid missing classes. We suggest implementing empty spaces at each time slot, that way students who walk by and have never heard of the event can attend the event without creating a crowded environment. The time-slot system has proven to be effective when gyms around the country implemented this tactic during the COVID-19 pandemic. This system acted as a form of crowd control as it helped keep everyone safe and isolated while providing gym enthusiasts with better time management. Additionally, we've been seeing this system in restaurants where dining establishments allow us to book reservations while also maintaining a limited number of seats for walk-in dining. We anticipate a few potential challenges regarding our recommendation, mainly involving project planning as it will be increasingly difficult to get the event's information out well in advance so enough people hear about it and book their space. Furthermore, there will be a greater administration demand as someone will need to create the time-slot system and administer the new process. There will still be a great number of students who want to drop in and there's the potential that the event's participation could be reduced due to the event currently following a first-come, first-serve method. Considering this possibility, planning out how many empty time slots to leave open is crucial. We believe that piloting this suggestion will be beneficial to student experience and incorporating other aspects such as a donut stand, music, and increase in volunteers can further benefit the ACCESS Tech Student Reuse Event. These recommendations will make the event seem celebratory as we want to celebrate our upcyclers in the same way that donors are celebrated.

Broadening Upcycling Inventory

Although many responses from students indicate that they came to the ACCESS Tech Student Reuse Event looking for something specific, students who came to the event purely out of curiosity are a prominent theme amongst interview responses. Students taking the time to attend the event with no specific purpose highlights the passions and interests that many of the student participants have for technology; willingly waiting through the long line-up and sign-in process with no guarantee that they will end up finding anything at the event. Those who come to the ACCESS Tech Student Reuse Event to explore the value of older technology with no expectations lead to a vast diversity of the inventory being upcycled. While some students show up to the event with the intention to find specific items that they had in mind, many come to take apart different electronics in order to find components that can be used for other purposes. We speculate that this is due to the engineering background that many of the students at the event possess since the upcycling drive took place at the Gerald Hatch Centre, an engineering building. With students having previous experience working with technology from their engineering degree, they owned the knowledge and skills on what electronic components were functional and what they can be used for. With their expertise, the technology that students were willing to upcycle was far more diverse than what the ACCESS Tech administrators may have perceived.

Based on this observation, our second recommendation is to broaden the list of inventories being offered to upcycle at the ACCESS Tech Student Reuse Event. Prior to the event, students express their interest in a limited number of items that they anticipate looking for such as tablets, laptops, desktops, keyboards etc. After seeing how student curiosity plays a major role in terms of what technology gets upcycled, this presents a possibility to expand the inventory to allow students to upcycle from a far diverse selection of electronic items. Students will also be more inclined to upcycle items that they aren't familiar with due to the free incentive the event provides. We are

aware of certain challenges associated with this recommendation as the ACCESS Tech coordinators wish to prioritize newer models due to a lack of storage space. While recognizing the scope of the project and how potential expansion of the inventory can become overwhelming, we propose opening more volunteer positions amongst the ACCESS Tech team to manage incoming technology. While we believe broadening the upcycling inventory would help improve student experience, the ACCESS Tech team still has a great understanding regarding what items are the most popular at the event and using the team's discretion on certain items is strongly recommended. However, even if some electronic items may seem old or useless, having people upcycle from a broader array of technology creates opportunities to discover exciting pieces while also ensuring that more technology gets properly recycled. Giving students the freedom to upcycle from a diverse inventory will enhance student experience as it will allow their creative minds to explore new possibilities from old technology that may have once been considered 'junk' or 'useless'.

Modular Designs & Circular Economic Principles

Despite the negative implications that e-waste has on the environment and on our health, the underlying issue is within the unique design of different technology. Currently, electronic manufacturers primarily focus on making a profit rather than considering environmental impacts. We've had our fair share of experiences when it comes to breaking our phone screens where getting the screen fixed would cost more than replacing our phone entirely; prompting us to discard our old phones and purchase a new one. This is a result of companies lacking the implementation of a modular design to their products. The modular design approach involves breaking apart a complex system into independent components that function independently of each other, which minimizes incidental interactions (Baldwin et al, 1998). An example of a modular design would be the computer, where its components such as the hard drive, graphics card, and power supply unit all function independently. With electronic manufacturers failing to implement modular designs and creating unique designs for their products, it creates difficulty when trying to recycle and reuse technology. Recycling complex electronic devices involves dismantling, size reduction, physical sorting, and other treatment processes, which consume a great deal of energy and negatively impacts the environment (Reuter et. al 2018). With the difficulty surrounding recycling complex electronic devices, it promotes discarding old devices to purchase newer models that will further promote e-waste. We suspect that the deviation from implementing modular designs is due to the unwillingness to change the current linear economy, where we find resources to make a product and later dispose of it once we're finished with it (Reuter et al, 2019).

Currently, there are other universities across Ontario that incorporate upcycling practices. An example would be Toronto Metropolitan University's *Branded Materials Transition Project* where they are upcycling Ryerson merchandise and apparel due to the institution's name change. Although many institutions have been implementing sustainable practices, McMaster University is unique in that their ACCESS Tech Drive is the only technology upcycling project amongst Ontario universities. Despite upcycling technology through the ACCESS Tech Student Reuse Event being a great sustainable practice, we anticipate that it isn't going to be a long-term solution due to our society not moving towards a circular economy despite the rapidly growing environmental issues. To create a solution against the current linear economy, our third recommendation is for McMaster University to start buying technology that implements modular designs to be used across campus and to instill policies that ensures that the electronic items the

university buys will be repairable. Actively implementing and using technology with modular designs holds several benefits as the reusable design allows for lower maintenance costs and efficient product upgrading for the users (Baldwin et al. 1998). Buying technology that consists of modular designs will allow electronics to be easily repaired without having to be thrown out entirely; being more cost-friendly while also promoting long-term sustainable practices across the institution. Increasing the usage of electronic devices that follow modular designs will promote a circular economy at McMaster University, an approach that maximizes the recovery of materials once products reach the end of their usable life (Reuter et. al 2019).

Promoting circular economic principles by implementing modular designs will benefit the university and the Hamilton region through the reduction of e-waste and its negative environmental impacts; which include landfill disposals and the oversaturation of toxic chemicals within water bodies. Circular economic principles also prioritize the recycling of used technology compared to a linear economy, in which technology gets thrown out once its use has come to an end. Implementing modular designs helps to promote the conversion of waste into reusable material and will further improve the recycling of used technology rather than increasing e-waste. With one of ACCESS Tech's primary objective of promoting the recycling of used technology, implementing technology with modular designs in order to establish a circular economy within McMaster University will improve the recycling of used technology and overall, reduce e-waste among the campus and within the Hamilton region. While the ACCESS Tech Student Reuse Event helps promote a circular economy by increasing the re-usage of technology, instilling a policy that ensures the purchase of technology with modular designs will provide a long-term solution towards e-waste management and the underlying issue regarding the current-day linear economy.

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Figures and Appendices

Appendix A

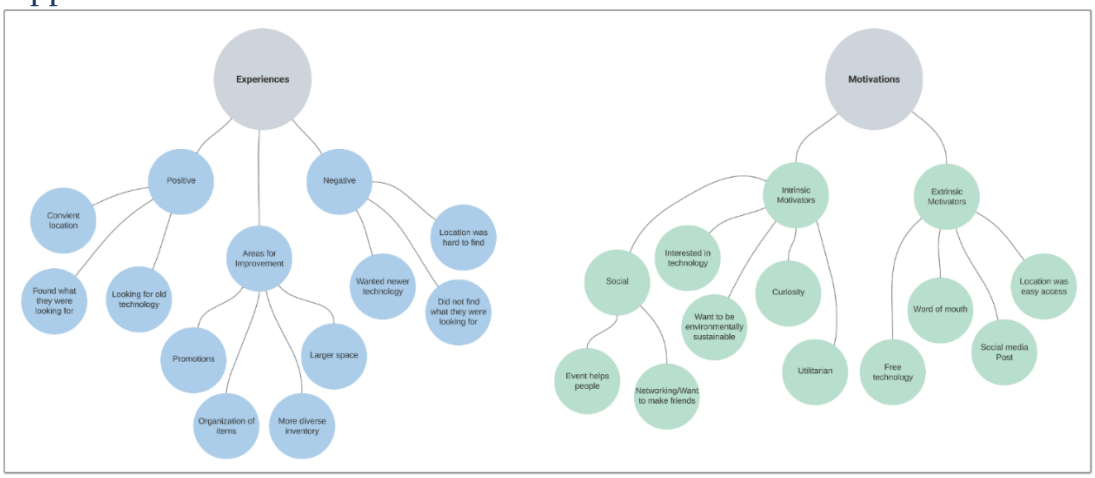

Figure A1. Original Thematic Map.

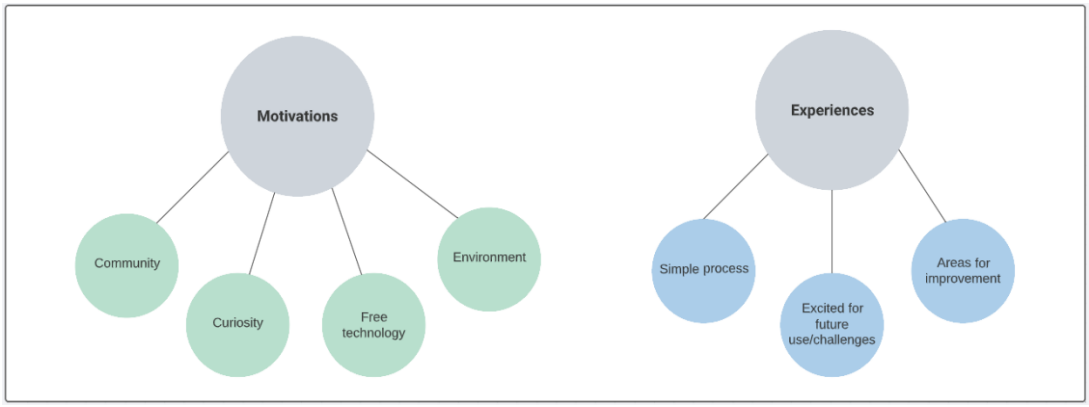

Figure A2. Final Thematic Map.