Delivering Carbon Literacy in Worcestershire Libraries

AN INTERACTIVE QUALIFYING PROJECT

Shannon Daly, Thomas Lamar, Reyna Loycano, and Kerri Thornton
WORCESTER POLYTECHNIC INSTITUTE | 100 INSTITUTE ROAD, WORCESTER, MA, 01609

Delivering Carbon Literacy in Worcestershire Libraries

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Submitted by

Shannon Daly

Thomas Lamar

Reyna Loycano

Kerri Thornton

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Project Advisor

Professor Rick Vaz

Project Sponsors

Dr. Stephanie Jones, Library Services Manager at The Hive

Katy Boom, Director of Sustainability at the University of Worcester

Dr. Sian Evans, Carbon Literacy Delivery Team at the University of Worcester

Abstract

Carbon literacy training can reduce individuals' climate impacts, but existing trainings are too time-intensive for the general population. In partnership with the University of Worcester and Worcestershire County libraries, we created, delivered, and evaluated two abbreviated carbon literacy programs. We presented these at six county libraries, collecting feedback to improve the programs. We recommend that: audiences be informed of the programs beforehand; programs focus on actions participants can take; the programs have a set start and end time; presenters know that prior knowledge of participants varies widely. We also created resources for librarians to continue the programs in their local communities.

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Executive Summary

Introduction

Climate change is rapidly accelerating due to human factors (Department for Business, Energy, and Industrial Strategy, 2019). Among the most dangerous emissions affecting our planet is carbon dioxide, one of the longest-lasting greenhouse gases in our atmosphere (Environmental Protection Agency, 2022). Carbon literacy is one approach to reducing an individual's carbon footprint; it raises awareness of one's emissions, teaches skills to lower them, and provides information on educating others about their own carbon footprint (The Carbon Literacy Trust, 2023). Carbon literacy training is currently available in industry and higher education through the Carbon Literacy Project, a UK-based organization which offers an eight-hour training course (The Carbon Literacy Trust, 2023). A shorter program would be more accessible to the general public and could be offered at venues such as public libraries.

The goal of this project was to create, deliver, and evaluate abbreviated lesson plans for the Worcestershire libraries to promote carbon literacy and provide possible changes to improve them. To achieve this, we:

1. Developed the programs based on participants', librarians', and University staff's feedback and tailored it to various audiences in the Worcestershire library system;
2. Administered and analyzed program effectiveness in terms of participants' responses to the programs and changes in behaviors; and
3. Provided resources and further recommendations to the libraries to improve the efficacy of the abbreviated carbon literacy training programs.

Staff Feedback

The abbreviated programs were delivered over the course of three weeks at six different libraries as separate adult and family sessions, with the latter geared toward young children. During the creation process, we met with various personnel such as library managers and University staff to determine what specifically they needed from such programs. They noted the following:

- Librarians are extremely busy; they need to be able to quickly learn and deliver these programs with as little preparation as possible.

- Librarians prefer and have had more success delivering programs to children; ensuring the attendance of adult audiences is more difficult.
- Both program types should engage the audience; however, the family program requires more interactivity to hold the attention of young children.
- Climate anxiety should be considered when discussing climate change with all audiences, especially young people.
- Programs should motivate participants to make meaningful changes to their everyday lives to be more sustainable.

Audience Feedback

While delivering the programs, we gauged audience feedback from two main areas: surveys and audience observations. To evaluate the programs, we administered surveys immediately before and after each session, along with one week later. We also noted participant behavior and verbal feedback during the delivery of the programs. From these observations, we found:

- Audiences were all aware of the topic of sustainability before participating in the program.
- Participants were more invested in sustainability topics that involved actions within their control.
- Participants were more engaged and cooperative when they were aware of the program session in advance; many did not appreciate attending their weekly club meeting to find it had been changed to a sustainability talk.
- Survey data revealed changes in respondents' habits. However, the combination of a small number of respondents and the short length of time between the program and follow-up survey makes it difficult to draw significant conclusions.
- The wide age range of children we encountered necessitated the creation of a third presentation for children under six, consisting only of an activity with short, individual discussions with parents about the activity and sustainability.

Program Development

When creating the program, we considered different criteria when choosing both the information and delivery of the program. The criteria were based on the possible impact of the

information, how the information would be presented, and if the information would negatively affect the participants. This was determined by personal experience as well as both staff and audience feedback and led to the development of the following criteria:

- Information was chosen to focus on the local effects of climate change to allow participants to form a better connection with it.
- Any content that may cause significant climate anxiety was avoided to not cause any unnecessary stress, especially during family programs.
- The focus of the program was largely placed on the impacts and personal actions participants could take as that was often what stuck with participants.
- Scientific information on the topic can be helpful, when used sparingly, to assist the audience in understanding how their actions are having an impact on the environment.
- Activities were used to allow participants to interact with the information they were being taught and increase their overall engagement with the program.
- The activities also gave participants an opportunity to see exactly what impact their personal actions can have on the environment, specifically in the case of what they eat.

Resources for Future Use

Following the completion of the project, librarians will have the option of continuing to deliver the program to their libraries. However, due to their busy schedules, learning an entire program can be a challenge in a short time span. To help them with future deliveries, we have created a template for an inexpensive, self-contained program that can be quickly learned and delivered by librarians. This includes:

- A family presentation, with a script for librarians to follow located in the speaker notes;
- An adult presentation provided for reference, with notes about each slide's information located in the speaker notes (less detailed due to librarians' decreased interest in the adult format);
- An activity sheet, used during the program to detail how to perform an activity and its relation to sustainability; and

- A video tutorial, which discusses the family presentation and provides a verbal explanation of the information.

These resources provide the librarians with a basis from which they can work when delivering programs. They can either work directly with these resources or, if they so choose, develop their own program from the information being provided.

Conclusions and Recommendations

Based on feedback received from both participants and staff, we developed the following recommendations for the future of the program. These suggestions will provide guidance for the librarians to deliver the program and make changes based on their specific audiences at their discretion.

- Focus content on actions and issues within participants' control to help keep them involved in the program.
- Inform participants in advance if the program is held during another group's event so that they have the opportunity to choose if they want to participate.
- Librarians know their community best; if they believe certain topics should be stressed or dropped from the training, they have the final say in its delivery to best fit the needs and interests of their local community.
- Avoid sessions without specific starting times, as the program's lecture-style format is most efficiently taught as a single delivery.

Recommendations for Future Work

For future evaluation of the program, we recommend the following steps be taken:

- Continue to evaluate offerings of the program, using results to modify it as needed.
- Have a longer waiting period (between one week and three months) before collecting follow-up surveys to provide time for adjusting to new lifestyles.
- Explore methods of promoting the program to those who may be unaware of sustainability to get them involved and introduce them to actions they could take to decrease their carbon footprint.

It is our hope that shorter, more accessible carbon literacy programs will be able to further spread the message of carbon literacy in Worcestershire County.

Authorship

This report was jointly written by Shannon Daly, Thomas Lamar, Reyna Loycano, and Kerri Thornton. The first draft of each subsection generally had one primary author, with subsequent drafts being edited and revised by all members. The presentation speakers for the slides located in Appendix A were Thomas Lamar and Kerri Thornton; Shannon Daly led the activity located in Appendix C. All members presented the slides in Appendix B. Kerri Thornton was the primary designer for the slides in Appendices A and B; she also handled the grammatical editing and formatting of this report. Tables and figures were created by Thomas Lamar and edited by all members.

Section	Primary Author(s)	Primary Editor(s)
Abstract	All	All
Acknowledgments	Thomas Lamar	All
Executive Summary	Shannon Daly, Reyna Loycano, Kerri Thornton	All
Introduction	All	All
2.1	Kerri Thornton	All
2.2	Thomas Lamar	All
2.3	Reyna Loycano	All
2.4	Shannon Daly	All
3.1	Shannon Daly, Kerri Thornton	All
3.2	Reyna Loycano	All
3.3	Thomas Lamar	All
4.1	Thomas Lamar	All
4.2	Reyna Loycano	All
4.3	Shannon Daly	All
4.4	Kerri Thornton, Thomas Lamar	All
4.5	Thomas Lamar	All
5.1	Shannon Daly	All
5.2	Shannon Daly	All
5.3	Shannon Daly	All
5.4	Shannon Daly	All
Appendix A	Thomas Lamar, Kerri Thornton	All

Appendix B	All	All
Appendix C	Shannon Daly, Reyna Loycano	All
Appendix D-J	All	All
Appendix K	Kerri Thornton	All

Table of Contents

List of Tables and Figures

Figures:

Tables:

Introduction

It is widely accepted that climate change is causing irreparable harm to the planet (McGrath, 2022). Greenhouse gases – the majority of which are emissions from human activity – are holding excess heat within the atmosphere, leading to a global temperature increase of 1°C compared to pre-industrialization (Department for Business, Energy, and Industrial Strategy, 2019). According to the United Nations (UN), fossil fuels are the main contributor; they make up over 75% of the world's greenhouse gas emissions and close to 90% of its carbon emissions (United Nations, n.d.). Carbon dioxide (CO_2) emissions – often called carbon emissions – are particularly malignant, due to CO_2's ability to remain in the atmosphere for hundreds of thousands of years (Environmental Protection Agency, 2022). Because of this long lifespan, carbon dioxide is the largest contributor to global warming out of all anthropogenic greenhouse gas emissions; it comprises "two-thirds of the total heating influence" of these emissions (Lindsey, 2022). Reducing carbon emissions, therefore, would help to mitigate the warming of the planet.

Carbon literacy is the awareness of the impact of an individual's carbon footprint on the environment and the efforts to reduce these emissions as individuals, communities, and organizations (The Carbon Literacy Trust, 2023). A person's carbon footprint represents the total carbon emissions that they may be causing (The Carbon Trust, 2018). When individuals are carbon literate, they can work towards making sustainable decisions and changes in their lives that decrease their footprint (The Carbon Literacy Trust, 2018b). Being carbon literate also allows individuals to help others become more carbon literate and develop their own methods of being sustainable (The Carbon Literacy Trust, 2018a).

Carbon literacy training is available to people in industry and at different universities through the UK-based organization the Carbon Literacy Project (CLP) (The Carbon Literacy Trust, 2023). The training done by the CLP has been shown to produce lifestyle changes that reduce participants' carbon footprint (Astbury and Tate, 2012), with the CLP stating there is on average a 5-15% reduction in carbon emissions after taking the course (The Carbon Literacy Trust, 2023). The CLP carbon literacy training has been administered to over 50,000 citizens worldwide (The Carbon Literacy Trust, 2023).

Despite the push for carbon literacy training in higher education and industry, there is significantly less access for the general public. In the public school system, there has been an effort to incorporate climate change education into the curriculum, but so far it has fallen short of that goal (Lengthorn and Asbury, 2019). This gap in teaching provides the opportunity for education in different venues to reach citizens of various ages and backgrounds (Allen et al., 2018). The eight-hour CLP training is long and arduous; a shorter, one-time program would be more accessible to the public, as it would allow them to work it more easily into their schedules. One way of organizing such a program is through public libraries, which pose a distinctive venue to promote carbon literacy in the public sector of Worcestershire County.

The goal of this project is to assist Worcestershire libraries to create, deliver, and evaluate abbreviated lesson plans to promote carbon literacy and provide possible changes to improve them. To accomplish this, we created our own abbreviated trainings based on the eight-hour program from the Carbon Literacy Project (CLP). These abbreviated trainings were delivered to participants at the libraries over the course of three weeks, namely separate adult and family sessions. Feedback from each delivery was used to further develop the training for subsequent sessions. Following the deliveries, we analyzed the program effectiveness in terms of audience engagement and changes in participants' behaviors. Based on this analysis, we recommended further changes to the libraries to improve the efficacy of the abbreviated carbon literacy training program. It is our hope that a shorter, more accessible carbon literacy program will be able to further spread the message of carbon literacy in the Worcestershire community.

Background

Climate change is drastically affecting the planet; in response, countries such as the United Kingdom are taking steps to decrease their emissions on a local and governmental level. One such response is carbon literacy, an ideology that aims to impact individuals' personal effect on climate change. Many organizations are working to spread this ideology such as the Carbon Literacy Project. It is striving to develop methods of teaching carbon literacy in schools and other learning environments such as the University of Worcester and The Hive. Together, they have an ongoing mission to provide a sustainable role model and resource to the community, continuing to push new ideas and collaborations.

1. Taking Action Based on the Urgency of Global and UK Climate Change

Around the world, the impact of climate change is hitting hard and is only becoming more severe; the United Nations (UN) has stated that many of these effects are now entirely irreversible (McGrath, 2022). Many countries have enacted regulations to decrease their negative effects on the planet, independent of or in conjunction with the UN. In this section, we detail the urgency of climate change and the steps the United Kingdom has been taking to mitigate its contributions to this critical issue.

1.1 Evidence for Climate Change on a Global and UK Level

Compared to pre-industrialization, the Earth's average temperature has increased by 1°C due to an abundance of greenhouse gases trapping heat in the atmosphere (Department for Business, Energy, and Industrial Strategy, 2019). This warming is contributing to the melting of glaciers, worsening droughts, and an increase in flooding. In the past century, global sea levels have risen an average of 20 centimeters (Department for Business, 2019). The rising has only gotten faster over time: from 2020 to 2022, the sea level rose 10 millimeters – a change that constitutes a tenth of the entire increase from 1993 to 2022, despite making up a mere 3% of the time frame (United Nations, 2022). The rising oceans have not been promising for sea creatures either, as our emissions have seeped into the water, decreasing its pH and leading to the death of many marine lifeforms (The Royal Society, 2020). Researchers Strauss, Kulp, and Levermann found that as of 2015, if the carbon emissions continued to rise at their current rate, the global

sea level would be up by 4.3 to 9.9 meters by the year 2100, displacing 20 million people in the United States alone (Strauss et al., 2015).

In the United Kingdom specifically, the temperature from 2008 to 2017 was an average of 0.8°C warmer than the average from 1961 to 1990 (Department for Business, 2019). If the global temperature increases by the projected 2°C, the temperature on land in the UK will end up seeing even warmer temperatures than this, resulting in an estimated additional 700 to 1000 annual heat-related deaths – not to mention the existing health problems that will be exacerbated by this temperature spike and the increasing air pollution (Department for Business, 2019). The Department for Business predicts that UK rivers will have 30% less water during dry seasons, leading to droughts and water scarcity; on the other hand, the wet seasons will suffer increased flooding due to 5-20% more water. This extreme fluctuation will have an overall negative impact on crop production, affecting food supply and contributing to malnutrition. According to Daniel Cohen, this scenario can only be avoided by decreasing our emissions and overall impact on the environment; the success rate of the emission reduction is heavily dependent on economic, citizen, and government action (Cohen, 2020).

1.2 National Goals Adopted by the UK to Address Climate Change

The United Kingdom has been at the forefront of the battle against climate change. In 2008, the UK government enacted the Climate Change Act, legislation that stated the UK would reduce emissions by 80% of its 1990 levels by 2050 (Department for Business, Energy, and Industrial Strategy, 2019). Between 1990 and 2017, it was able to decrease its emissions by 42%; however, after reevaluating the urgency of climate change, the UK amended its Climate Change Act in 2019 to work towards net zero[1] by 2050. This was in part spurred by the 2015 Paris Climate Agreement, an international treaty created to decrease worldwide carbon emissions (United Nations, n.d.-b). Participating nations are required to submit 5-year plans detailing the steps they will take to minimize their emissions by the next commitment renewal date. The UN also has long-term goals for all participants, though the adoption of these is optional (United Nations, n.d.-b). Across the European Union (EU), organizations such as the European Social Fund Convergence Programme (ESF+) were created to benefit all countries in the EU; although the UK is no longer part of the EU at the time of authorship, its history in this organization nonetheless impacted its attitudes towards climate change. One of the projects the ESF+ funded was the Clear About Carbon project, which aimed to increase awareness surrounding climate

change and teach companies, suppliers, and their employees how to reduce their emissions (Finnane, 2013). Among the main findings of this project was that it was more beneficial for companies to integrate these sustainability programs into the existing company culture, rather than holding a standardized training course (Correia et al., 2011). It is important to note that while the project was funded by the ESF+, it was created by the University of Exeter Business School. In partnership with the Cornwall Development Company, Duchy College Rural Business School, and the Eden Project, the program was carried out specifically for the benefit of companies in Cornwall (Correia et al., 2011). Although it received governmental support, credit for its inception belongs to universities and those in the private sector – without whom change would be nearly impossible.

1.3 Citizen Actions to Address Climate Change in the UK

Based on the UK government's actions – or lack thereof – citizens and independent organizations have put forth their own guidelines to mitigate emissions. In 2019, the University of Worcester announced its Climate Emergency Declaration regarding the current state of climate change and what it would be doing to combat it (Lengthorn and Asbury, 2019). Recognizing the lack of climate change curricula in the current education system, the University began integrating the United Nations' Sustainability Development Goals into its courses and overall culture, as well as educating professors on how to teach climate change. For its work, the University received the Green Gown Award in 2019, making it the Sustainability Institution of the Year. This same year, the Worcester City Council also announced its own Climate Emergency Declaration, along with its plan to take steps to help Worcester be carbon neutral by 2030 (Lengthorn and Asbury, 2019).

According to Lengthorn and Asbury, less-than-impressive government initiatives have spurred younger generations to step up and support the cause, creating groups like the UK Student Climate Network (UKSCN) which held over 850 demonstrations in 2019 alone (Lengthorn and Asbury, 2019). Similarly, Teach the Future is a student-led organization whose goal is to revamp the UK's education system to be more climate-centered. In 2020, it commissioned a research study to survey teachers regarding how climate change is taught in schools; the study found that while 92% of educators were concerned about climate change, 41% said it was mentioned rarely if at all in any of the school's courses. A mere 5% stated that it was a significant part of their curriculum. In 2021, Teach the Future published additional findings,

stating that 70% of teachers reported having no training whatsoever on how to educate students about climate change (Lengthorn and Asbury, 2019).

2. Carbon Footprint and Carbon Literacy

According to the UK-backed sustainability organization The Carbon Trust, a personal carbon footprint "is the total greenhouse gas emissions caused directly and indirectly by a person" (The Carbon Trust, 2022). Organizations have taken up the task of educating individuals about personal carbon footprints. This section discusses government actions towards personal carbon footprints and the carbon literacy efforts being made to bring awareness to them.

2.1 Government and Carbon Footprint

Personal carbon footprints have a significant impact on carbon emissions. For example, Hertwich and Peters (2009) found that over 60% of the United Kingdom's carbon emissions could be traced back to household consumption; in other countries, such as the United States and Russia, that number is over 80%. Because of this, governments institute policies and regulations aimed at curbing an individual's personal carbon footprint. Places such as California, China, Tokyo, and South Korea have all implemented some variation of a carbon tax to regulate the consumption of carbon dioxide (Rafaty and Grubb, 2018). Carbon taxes seek to lower the demand for carbon-intensive products by levying a tax on items that cause high carbon dioxide emissions in use and manufacture. Even at local levels of government, plans have been made that acknowledge the impact of personal carbon footprint. In its 2009 Stakeholder Climate Action Plan, the City of Manchester noted a need for a "low carbon culture" in the city. The more recent Manchester City Council Climate Strategy shows the same desire: "Carbon literacy will become embedded into the culture of organisations, lifestyles and behaviours" (Manchester City Council, 2018).

2.2 Carbon Literacy

Carbon literacy is defined as "an awareness of the carbon dioxide costs and impacts, and the ability and motivation to reduce emissions on an individual, community, and organizational basis" (The Carbon Literacy Trust, 2023). Individuals and organizations take carbon literacy training to equip themselves to reduce their carbon footprint. According to researchers Astbury

and Tate (2012), carbon literacy allows individuals to understand and decrease their daily impact on the environment.

Studies have found that carbon literacy training is effective at reducing carbon footprints. Astbury and Tate concluded that the training resulted in lifestyle changes by the participants (2012). Another study found that carbon literacy training performed on the set of the British soap opera *Coronation Street* resulted in the production reducing carbon emissions by 96 tonnes between 2014 and 2016 (Chapple et al., 2019), equivalent to taking roughly 57 cars off the road (Yurday, 2022).

2.3 The Carbon Literacy Project

Founded in 2012, The Carbon Literacy Project (CLP) is a UK-based not-for-profit charity dedicated to the teaching of carbon literacy (The Carbon Literacy Trust, 2023). Since then, the CLP has administered carbon literacy training to over 50,000 individuals in 18 different nations (The Carbon Literacy Trust, 2023). According to the charity's website, they have saved 177,000 tonnes of carbon dioxide from being emitted. In 2015 the Carbon Literacy Project was recognized by the United Nations Transformative Action Program as a TAP100 organization (Local Governments for Sustainability, 2015), meaning the charity was among the top 100 best responses to climate change.

The Carbon Literacy Project promotes carbon literacy through custom courses. According to the CLP, carbon literacy training is aimed at "those who live, those who work, and those who study," and the courses that are taught must be customized to impact the specific audience being taught (The Carbon Literacy Trust, 2023). Overall, the CLP has designed 441 courses in order to administer training (The Carbon Literacy Trust, 2023).

3. Teaching Carbon Literacy

An understanding of carbon literacy can play an important role in many people's comprehension of sustainability and the environment. In order to work towards carbon literacy many organizations have begun developing methods to spread understanding of individuals' carbon footprints. In this section, we discuss how organizations have approached carbon literacy and possible methods of teaching it.

3.1 Carbon Literacy in Schools

The Carbon Literacy Project is working to integrate carbon literacy into various universities to ensure students are aware of their contributions to climate change. A major university involved in this process is Manchester Metropolitan University (MMU) which works with the CLP to implement the program (Manchester Metropolitan University, n.d.-a). MMU began including the training in its degree programs (Manchester Metropolitan University, n.d.-b). The CLP has also extended its reach to the United States, working alongside the University of Massachusetts Amherst (UMass Amherst), where a cohort of undergraduate students from the University was trained and certified by the Carbon Literacy Project to teach carbon literacy to their peers (Sustainable UMass, n.d.). Alongside MMU and UMass Amherst, the Carbon Literacy Project has worked with other universities; these include but are not limited to the University of Queensland in Australia, De Montfort University in Dubai, and the University College Cork in Ireland.

Independent of the Carbon Literacy Project, universities have made attempts to promote both carbon literacy and general sustainability practices in their schools. One such institution is the University of Worcester, which is following a similar plan to MMU by working to integrate sustainability into its classes and having a goal of being net zero by 2030 (Education and Learning, n.d.). The University of Worcester also provides opportunities for students to participate and run projects such as their Go Green Week to help work towards a greener community (Community Involvement, n.d.).

Despite the work that universities and other schools are putting into integrating sustainability into their curricula, there are challenges that often prevent or hinder these efforts. According to Hindley, even with a greater push for sustainability in education, it remains outside of many schools' normal curriculum; often, the power to make this change is not in the hands of those working to alter the courses (Hindley, 2022). Veron et al. also note that these impediments can affect the teachers' capacity to educate about sustainability in their classes as they feel they do not have the time and resources to properly teach it (Veron et al., 2016).

3.2 Climate Anxiety

Environmental education is not just important in higher education, it is also a prominent subject for younger children in school. This can cause emotional distress in children about the future of the planet, which is known as climate anxiety. Climate anxiety is the "anxiety

associated with perceptions about climate change" (Clayton, 2020). Research has shown that children and adolescents experience more climate stressors than adults, which when combined with their developing brains leads to being "more susceptible to negative climate-related health effects" (Crandon et al., 2022). Additionally, literature suggests that in most formal classroom education, children may learn about the urgency of climate change but are not given opportunities to fix it (Trott, 2017). Compounding on this, Trott's research suggests that children's anxieties around climate change increase when they are not able to engage in potential actions against climate change (Trott, 2017).

On the other hand, a study by Ojala (2012) found children and adolescents to be more hopeful about climate change knowing they can personally do things to address it. This optimism can be seen in the *Science, Camera, Action!* (SCA) climate education program, an afterschool program that ran in Colorado, USA. SCA equipped participants aged ten to twelve with cameras to document their local environments and draw connections between climate change and their local ecosystem (Trott, 2017). Even though participants were conscious of climate change, Trott found that the program nonetheless "promoted children's hope and wellbeing" (Sanson et al., 2022). Furthermore, the program increased participants' confidence in their ability to be part of the climate solution (Sanson et al., 2022).

3.3 Methods for Teaching Carbon Literacy

There is not one single method for teaching people about carbon literacy and sustainability. For example, Linda Too and Bhishna Bajracharya wrote about a model they used referred to as the 6-P framework, allowing them to look at universities' sustainability practices. From the 6-P framework, the authors determined it was necessary to engage people from several different points of view to properly educate them on carbon literacy and sustainability. These points include looking from the view of psychological needs, physical needs, personal motivations, public perception, price, and policies (Too & Bajracharya, 2015). The United Kingdom's government website details how it teaches students about sustainability and climate change from a young age through various fields in their education. Additionally, the UK intends to set up activities that will allow students to learn in natural environments, giving them more practical experience (Sustainability and Climate Change, n.d.).

Another approach to teaching people about climate change is through more interactive means that allow them to be more actively involved in the learning process. A 2023 study by

Georgios Mylonas et al., found that games can be an engaging method for involving people in learning environments. The study analyzed an app called the GAIA Challenge, which has students working together on "quests" and displays their impact on the school's energy consumption. The overall response to the challenge was encouraging; 57% of the students reported they had learned from the game (Mylonas et al., 2023). Other options are available that could be used in daily life, such as the Digital Grocery List designed by Hedin et al. (2022). With the help of this grocery list, people could be informed about the emissions associated with their food, allowing them to become more aware of the associated environmental costs. These methods could be further improved by adding a feature that suggests alternate products that may be more sustainable (Hedin et al., 2022).

When designing methods to teach people, the characteristics of a group can also play a role in how effective the method may be. For example, the Programme of International Student Assessment (PISA) conducted a survey of 15-year-old students and determined that only 55.7% felt they knew anything about climate change (Oliver & Adkins, 2020). Because all participants may not be equally informed on the topic, having different methods of training based on their backgrounds and education level can prove useful in ensuring an audience's understanding. At the Manchester Museum, the Carbon Literacy Project helped develop two potential methods of delivering carbon literacy: one geared towards adults and one geared towards children. The first is discussion based, involving individuals' carbon footprint, while the second involves hands-on activities for younger children and families (Baggaley, n.d.). Training can also be specialized to specific groups, such as in the case of engineering students as discussed in a study by Denise Wilson. She found that these students were far more interested in sustainable energy and waste electronics than students in other fields of study. She concluded that using these key concepts when teaching the students could help expand their interest in other areas of sustainability (Wilson, 2019).

3.4 Carbon Literacy in Libraries

According to Devine and Appleton (2022), there is "very little [literature] about the education role of libraries" regarding climate change; they note that there are no overarching recommendations for the instruction of environmental issues at all. One piece of literature the authors pointed to was Beutelspacher and Meschede's (2020) study of 54 German public libraries, which found that 56% of libraries offered general information events on sustainability.

Despite the lack of guidelines for addressing environmental issues, many libraries still work to educate the public on climate change.

4. Increasing Carbon Literacy at the University and Worcestershire County Libraries

This section recognizes the ongoing mutual goals the University of Worcester and the public library system of Worcester have to create a more sustainable future. Through a collaboration with The Hive, a public and university library, both organizations have brought a new perspective on collaborative efforts to increasing awareness of carbon literacy and offer unique opportunities for both university students and citizens.

Figure 1

Exterior of The Hive

Note. By S. Daly, 2023, photograph, taken in Worcester, UK.

The Hive represents the efforts of both the city of Worcester and the University of Worcester to bring the community closer and provide a unique opportunity to combine resources, presenting a new library experience for the public sector. The Hive (see Figure 1) is a distinctive building in its architecture, collaborative thinking, sustainability goals, and ownership. On July 2nd, 2012, Queen Elizabeth II officially opened The Hive (University of Worcester, 2012). Its name was chosen for the building's resemblance to a beehive in its structural appearance, strong feeling of community, and "purposeful activity" (University of Worcester, 2012). The Hive's

architecture serves as an example of an eco-friendly building and could inspire future sustainable projects. One unique feature of The Hive is its use of river water to regulate its internal temperature by pumping water through the cement walls, cooling the library in summer and warming it in winter, which reduces operational costs (University of Worcester, n.d.-a).

The University of Worcester has a mission to create a sustainable campus, foster a carbon-aware community, and inspire students to pursue climate activism post-graduation (University of Worcester, n.d.-d). In 2005, it formed the Sustainability Strategy Group (SSG) to hold itself accountable for its actions. The SSG annually develops a report to evaluate the University's sustainability efforts (University of Worcester, n.d.-d). One such effort is that the hot water in the University's residential halls is predominantly heated by the sun, decreasing energy use for temperature control (University of Worcester, n.d.-d). As mentioned in Section 1.3, the University was recognized as the 2019 UK's Most Sustainable University (University of Worcester, n.d.-d). The University stresses individual responsibility in limiting one's carbon footprint.

The Hive is owned by both the University of Worcester and the Worcestershire County Council as Worcester's public library (Allen et al., 2018). This unique relationship allows the university and town to collaborate and offer opportunities to its students and community members (Allen et al., 2018). This collaboration was born out of a mutual mission of giving back to the community, increasing interest and usage of the public library system, and providing a resource and space for university students (Allen et al., 2018). The Hive offers Worcester a wide range of resources for students and citizens to get involved with their local community; it serves as a platform to educate, connect, and give back. A business center was integrated into the design of the building in July 2012, which allows the community to learn from expert advisors, collaborate, and use their tools to build local businesses (Allen et al., 2018). The Hive also offers events and training as well as traditional resources like databases and journals. In addition, it is a venue for networking and learning on a university and real-world level. Because The Hive and the University of Worcester have similar sustainability goals for the community, they decided to collaborate to spread carbon literacy to the public. To achieve this, they have partnered with libraries across the county to help their message reach a wider base and be more accessible to a wider audience than being at one centralized location. With this diverse audience and strong goal of sustainability, the University, The Hive, and the local county libraries want to use local

libraries as a platform for carbon literacy information to be available to all their citizens across the county.

Methodology

The goal of this project was to assist Worcestershire libraries to create, deliver, and evaluate abbreviated lesson plans to promote carbon literacy and provide possible changes to improve them. To do this, we created the following research objectives:

1. Develop the programs based on participants', librarians', and University staff's feedback and tailor it to various audiences in the Worcestershire library system;
2. Administer and analyze program effectiveness in terms of participants' responses to the programs and changes in behaviors; and
3. Provide resources and further recommendations to the libraries to improve the efficacy of the abbreviated carbon literacy training programs.

In this chapter, we will discuss how these objectives were achieved through consulting with librarians and audiences, analyzing how well the trainings worked, and formulating recommendations for the University of Worcester and the public library system based on the findings for the project.

1. Develop and tailor programs for various audiences

The first objective was to create two abbreviated versions of the carbon literacy training program so that it can be delivered to audiences of varying age groups, one being for families with children aged five to twelve, and one for an adult audience. The eight-hour program from the Carbon Literacy Project (CLP) is unlikely to be equally effective and accessible across all groups; we also took this program ourselves before arriving onsite to get a feel for the strengths and weaknesses of the original course. By creating our own shorter versions of the same content, for different demographics, we aimed to expand its reach and efficacy while preserving its core information. As we learned about the program's target demographics and the challenges they face, we employed various strategies tailored to each group for teaching carbon literacy and motivating individuals to decrease their carbon footprints. To accomplish this objective, we identified the following research questions:

1. What were our personal experiences as participants in the eight-hour carbon literacy training course?
2. What content should be retained and/or revised from the eight-hour course?

3. What are the University of Worcester staff's impressions of the abbreviated programs? How might they differ from our own?
4. To what extent are the abbreviated programs appropriate for their age groups? What lessons from previous program sessions can be used to tailor the programs to different audiences?

By answering these questions, we aimed to determine how to create the abbreviated programs in a way that will be suitable for all its audiences in the Worcestershire area.

As we began working towards these objectives, we communicated with key personnel such as the library and University staff about their experience with the previous year's program. The personnel we worked with are Dr. Stephanie Jones (Hive contact), Katy Boom, Dr. Sian Evans, and Gill Slater (University of Worcester contacts). Through our meetings with these personnel, we learned their opinions on the past years training program and received advice for our future trainings. Along with an understanding of audience knowledge, these were used to develop criteria for the information that would be included. The activities for the program were chosen using similar criteria to determine what would engage participants with sustainability. As the programs progressed, we considered the data from each session to alter and improve subsequent ones.

Throughout the creation of the family program, information was carefully chosen to avoid causing the children unnecessary consternation or climate anxiety. Another limitation we faced was accommodating the full work schedules of the University and library staff when looking to gather information from them.

2. Administer and analyze program effectiveness

Overall, we administered three programs at six different locations over eleven sessions. Of these, five involved adult audiences and six involved family audiences. As the delivery of the programs at the libraries progressed, we gathered and analyzed data from the participants to ascertain the effectiveness of the new program at encouraging greener habits from participants. Observing how the participants react assisted in determining how effective, or ineffective the program can be in changing their attitude towards sustainability; it also assisted in providing better insight on the ways different age groups learn. Gaining an overall understanding of how to approach participants about their opinions on sustainability can be useful in evaluating their true feelings on the subject. We devised the following research questions to guide our understanding:

1. What aspects of each training program are the most and least influential on participants' behaviors? Why?
2. What challenges are associated with delivering the programs to each of the different age groups?
3. Does the choice of program environment, organization, advertisement, and/or mode of delivery influence participant learning and willingness to change their habits?
4. How can participants' level of engagement and reception of the program be used to guide improvements to it?

Answering these questions allowed us to understand the audience's opinions on the program and helped us determine the effectiveness of the program.

To accomplish this, three surveys were conducted to collect participants' opinions of the training: a pre-survey (Appendix A), a post survey (Appendix B), and a follow-up survey (Appendix C). Each lasted approximately five minutes and were tested by Katy Boom, the Director of Sustainability at the University of Worcester, and thirteen college students from the United States before being given to local audiences of varying ages and education levels to ensure that they are easily understood and communicate what we intend them to. The first survey was provided at the beginning of the training sessions, using the questions found in Appendix A. It was used to determine participants' current habits and understanding of sustainability. Any minors present in our program were always supervised by their guardian, and all surveys were given to the guardians. The second survey was provided immediately after the training session, being given to either the participant or – in the case of families – a guardian. Special care was given to ensure the well-being of all minors participating in our program. Surveys assessed the participants' understanding of the training and allow them to provide feedback on the engagement of the program. Along with the questions, as found in Appendix B, the survey also collected emails or other contact information from voluntary participants to facilitate the third survey. This survey was sent seven days after the training, unless such time falls on a weekend; in this case, it will be sent on the following Monday. It contained similar questions to those in the first survey to help us determine if the training provoked change from the participants and/or their behavior.

The surveys did present some challenges in the form of biases. A major bias that was present in these surveys is social desirability bias; this is the tendency for people to respond in a

way that makes them appear more favorably. As the program was working with environmental sustainability, participants may have chosen to answer with what they felt is the most sustainable option. However, we do know that non-response bias – the bias that those who responded were likely more invested in the area of study – is present in the final survey; participants who were not invested in sustainability or are skeptical of climate change might have been less likely to respond.

The collection of data also faced several limitations over the course of the different programs. Namely the rather small sample size that we received means that we cannot be certain that the data is truly representative of the entire population of Worcestershire. Some of the participants were also intending to attend events separate from our program which could have affected the answers that they provided or if they participated at all.

Additionally, we as presenters posed a limitation to the audience. The creation of the program is inherently biased by our existence as American university students, due to our different backgrounds and ways of speaking from British children and adults.

3. Provide recommendations and resources to Worcestershire Libraries

The final objective was to develop practical recommendations and provide useful resources for the Worcestershire libraries regarding administering the carbon literacy program. Using information from participant feedback and surveys, meetings with staff, and observations made while administering the training program, we drafted recommendations and create resources for the Worcestershire libraries. We used the following research questions to further guide the recommendations:

1. To what extent are the Worcestershire County libraries able to administer a carbon literacy program with their current infrastructure?
2. What tools, strategies, and training would prepare library staff to administer programs in the future?

Answering these questions identified the current abilities of the libraries to offer carbon literacy programs and provide insight on the resources needed for the libraries to administer their own carbon literacy programs.

To gauge the needs and abilities of the Worcestershire County libraries, we partook in a 45-minute meeting in which five library managers representing the six libraries we delivered programs to were present. Synthetizing the insights gained from the librarians with information

on program effectiveness, discussed in the previous section, we provided the libraries and University staff with a copy of the report with our final recommendations on improvements to the program as well as a carbon literacy training program ready to be delivered. This program will include all the tools, lists of materials, and strategies we have developed in teaching Worcestershire County library audiences about carbon literacy.

These deliverables may be hindered by the small number of adult and family programs delivered, which allowed for limited experimentation in implementing potential improvements into the program.

Findings

In this chapter, we begin by identifying the content from the carbon literacy program that particularly engaged participants. Next, we consider the impact of different delivery methods on adult audiences. Similarly, we then review our findings on different methods of delivery for a family audience. We then discuss audience feedback on the program. Finally, we speak to the needs of the Worcestershire County libraries in delivering carbon literacy programs in the future. These findings suggest effective methods of teaching carbon literacy and serve as the backbone for recommendations to the libraries on how to host a carbon literacy program.

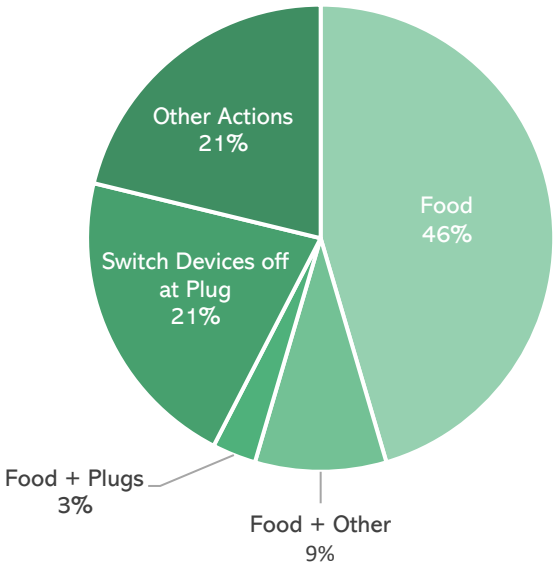
1. Effective Program Content

In this section we present findings regarding carbon literacy content shared with audiences. We first comment on the program material that participants found most engaging, followed by the content with which participants engaged less. We conclude this section by discussing the impact of providing background information on climate science with different groups.

Participants engaged with and learned most from material covering the carbon footprint of food. Of those who completed the post-program survey, 58% (19/33) mentioned learning about the impact of food on their carbon footprint. One participant noted in their survey response that they "loved the BBC food calculator" (Stylianou et al., 2019), finding it "very interesting and informative." Additionally, of the survey respondents who mentioned food, 68% (13/19) noted the impact of meat consumption on their carbon footprint.

Figure 2

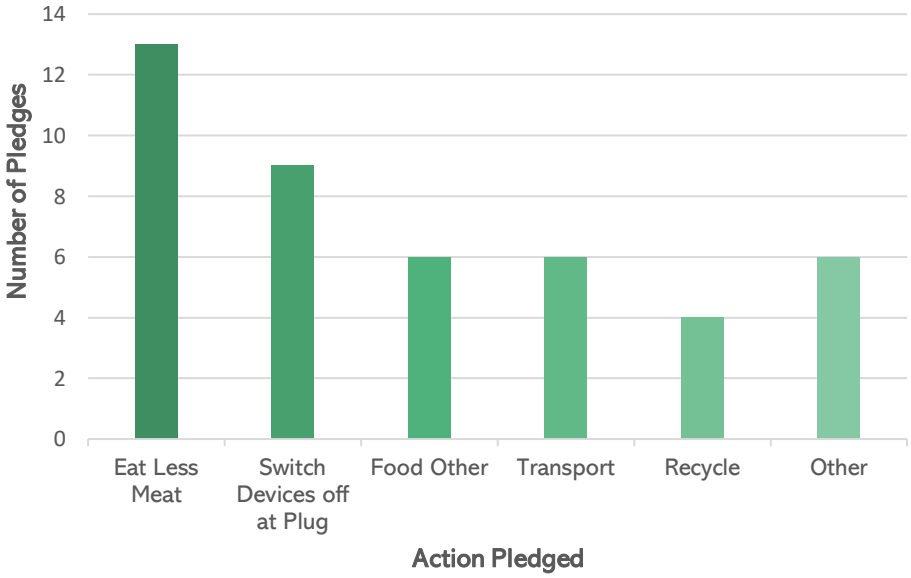
Participant Pledges by Topic



Note. This graph categorizes the actions each respondent pledged to take. This indicates that 58% of respondents mentioned food in their pledge. Total n = 33.

Figure 3

Sustainable Actions Pledged



Note. This graph categorizes each pledge made by participants, with some participants pledging multiple actions. n = 33.

Adult audiences were most interested in carbon literacy topics related to actions they felt they could control. When addressing the impacts of air travel, the program mentions flying less and on more fuel-efficient planes. One audience member objected to this, arguing that they cannot control what type of aircraft an airline operates. A similarly frustrated sentiment was expressed when the program covered electric vehicles and solar panels; many participants noted that buying an electric car or installing solar panels was not an economical option for them. Conversely, one's diet is an area in which individuals feel they have full control; this likely contributed to the increased participant engagement observed while discussing the carbon footprint of food.

Providing a scientific background on climate change was seen as helpful by audiences at events advertised and dedicated solely to our presentation. One respondent from an adult stand-alone session commented that "it was good to go back to basics and understand what amounts to our carbon footprint." Similarly, another participant noted that this background added context to their prior knowledge. While presenting this information at stand-alone events, we found that participants' actions and body language suggested they were engaged in this content. On the other hand, at non-stand-alone sessions, the audience seemed more apathetic during this section of the presentation.

2. Lesson Learned from Adult Sessions

Working with the adult participants during the program revealed key details regarding methods of engaging the participants. Two major delivery formats were used: lecture-style and discussion-based. In the lecture-style sessions, the bulk of the information was conveyed using a standard lecture format with interactive portions, allowing participants to get involved throughout the presentation. In the discussion-based sessions, the format allowed for a more personal message to be conveyed at the cost of much of the technical information. These events received the greatest audience engagement when participants were also aware of the program prior to it being given to them.

Lecture-style programs allowed for a variety of carbon literacy topics to be covered in a single session. Lecture-style formats allowed us to dictate the pace and material covered in a program session. Using slides as visual aids mixed with interactive content allowed us to touch on many different carbon literacy topics.

Interactive activities during the program increased audience engagement and impact. As observed during the programs held in Bromsgrove, Malvern, and Worcester at The Hive, groups became much more invested in the content of the lecture when given the opportunity to explore it for themselves. Activities such as CNN's Climate Change Solutions Quiz – a quiz involving the ordering of climate change solutions based on carbon impact – also provided a further opportunity for participants to collaborate (Kann et al., 2019). This allowed for group expression of ideas and opinions on fighting climate change, resulting in a greater impact of discussed topics. One such activity was the BBC food calculator, a tool with which participants were particularly engaged; as previously mentioned, 58% (19/33) of respondents of the post survey reported learning about the environmental impact of their food.

Discussion-based programs covered less content but were helpful for groups who did not want to participate in the lecture-style training. In scenarios where groups may be uninterested in a full lecture-style presentation, many were still willing to participate in a conversation about sustainability for anywhere from five minutes to an hour. Regardless of the conversation outcome, we were nonetheless able to provoke meaningful reflections on climate change and its impacts; some provided personal actions to lower their carbon footprint such as limiting oven use to once a week or meat consumption to the amount on the food pyramid. However, due to discussions being participant-led, we were unable to cover all the information found in the lecture-style program.

Audiences were more responsive and engaged when they were aware of the program ahead of time. Participants at one library were members of a knitting group and were not expecting a presentation when they arrived. While they were willing to participate, audience engagement and interest was noticeably lower than at programs delivered at where the session was advertised ahead of time. At one library, individuals were unwilling to participate in the program at all; this was made clear both verbally and through body language, as they sat facing away from the presentation screen.

3. Discoveries from Family Sessions

While working with the Worcestershire libraries, we found that the family sessions – geared towards children – had generally higher attendance than the adult sessions. However, the age range proved to be too broad for one overarching program to both hold their attention and

have a meaningful impact on each participant. The original family program would work better with children roughly six to ten years old; a separate, more activity-oriented program for those under six and a more informative session for those over ten would be more age-appropriate for these groups. Overall, we found that each group of children is unique in their interests, backgrounds, and prior knowledge; taking into consideration the individuality of each group is important in making a meaningful impact.

Family sessions need to be targeted to a smaller, more specific age range. When creating the program, we intended to deliver it to an audience between the ages of five and twelve years old. During our sessions, we observed the older children zoning out during our presentation, with some becoming disinterested in our hedgehog activity. One respondent noted that their "older child would have enjoyed a quiz or something other than a craft activity." Simultaneously, some younger children would draw, walk around, or play with toys during the presentation; however, these same children were very engaged with the hedgehog activity. A different respondent noted that the "language used, and content [presented] was too high for young children who attended."

For younger age groups, it worked best to forgo the presentation and take a discussion-based approach. As previously mentioned, younger children struggled to sit through the presentation but engaged well with the craft activity. For sessions exclusively with young children, forgoing the presentation entirely and focusing on a hands-on activity while having a discussion with the child and their guardian about climate related issues produced the most engagement.

Audience engagement was highest when presenting to a children's eco-group. We delivered a program to a group centered around environmental interests; of all the family programs we delivered, both the children and parents were the most engaged at this presentation. Many of the children were already able to describe climate issues to us and were eager to learn actions they could take to lower their carbon footprint. This group's increased audience engagement was largely due to their prior interest and experience with environmental issues; their baseline interest in the topic was higher than the average participant.

4. Audience Impact

Throughout the program deliveries, we were able to observe and record participant reactions to the content presented. At most of the events, participants were knowledgeable on sustainability, leading to some stating that they did not need to be taught. Despite this, some of the participants were still able to change their habits. Unfortunately, our response rates were too low to truly conclude the impact that the program may be having on their behavior. Some participants had also already been following a variety of habits throughout their lives, leading to their frustration with society's handling of sustainability over the years.

Many people who showed up to program sessions had prior knowledge of climate change and sustainable living. Surveys distributed before the training began revealed that 88% (30/34) of survey respondents stated that they knew and could define the term carbon footprint. The remaining 12% of respondents noted they knew of the term carbon footprint but could not define it. Not a single respondent stated they had not heard of the term carbon footprint before. Additionally, in a discussion after one session, a participant asserted that the audience did not need to be persuaded on climate change, claiming that our program was "preaching to the converted." At a different session, two members of the Green Party, a political organization whose website states it is the "party of environmental justice," (Core Values, 2013) attended a program session as well, indicating that their previously held beliefs already aligned with the message of the presentation.

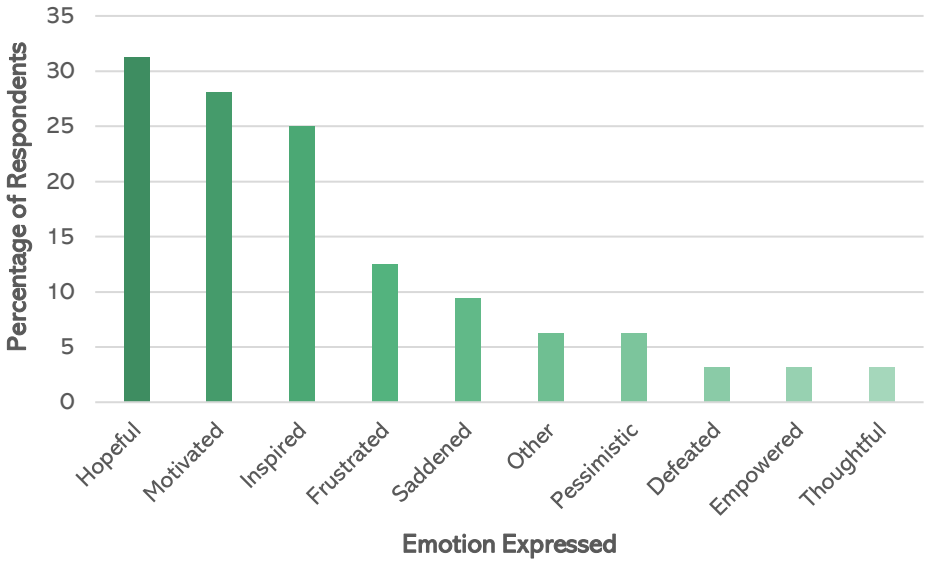
Participants had a more positive viewpoint on an individual's impact on global climate change after attending a program session. When asked prior to the session whether they believed that an individual could impact the global climate, 94% (32/34) of respondents selected an answer equal to or more affirmative than "maybe." After the session, this percentage increased to 100% (10/10) of respondents.

Most participants expressed positive emotions immediately following the training. As can been seen in Figure 4, the most frequently reported feelings after the training were "Hopeful" (31% of participants), "Motivated" (28%), and "Inspired" (25%). Individual responses were categorized by expressing solely positive emotions, solely negative emotions, or a mix of positive and negative emotions, as seen in Figure 5. This revealed that 72% of

participants left with exclusively positive emotions, while only 9% of participants left with exclusively negative emotions.

Figure 4

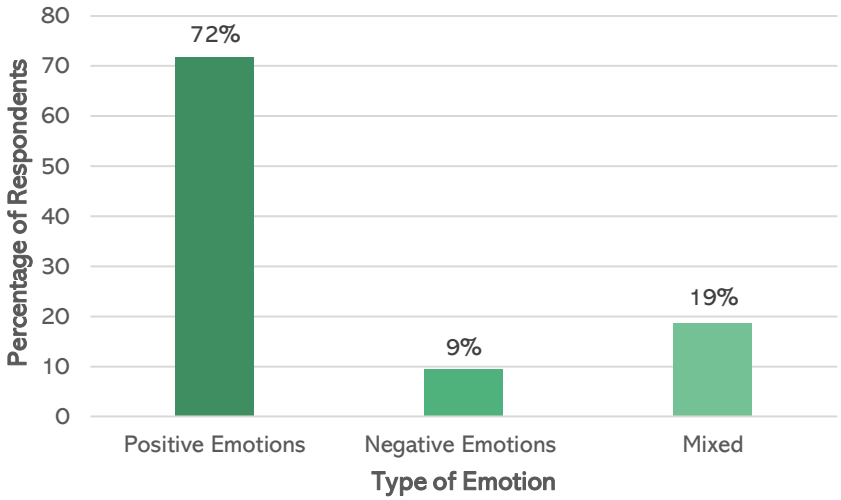
Emotions Experienced by Participants after Training



Note. This graph shows the percentage of respondents who reported feeling that emotion. Respondents could report more than one emotion. Total n = 32.

Figure 5

Emotion Types per Participant after Training

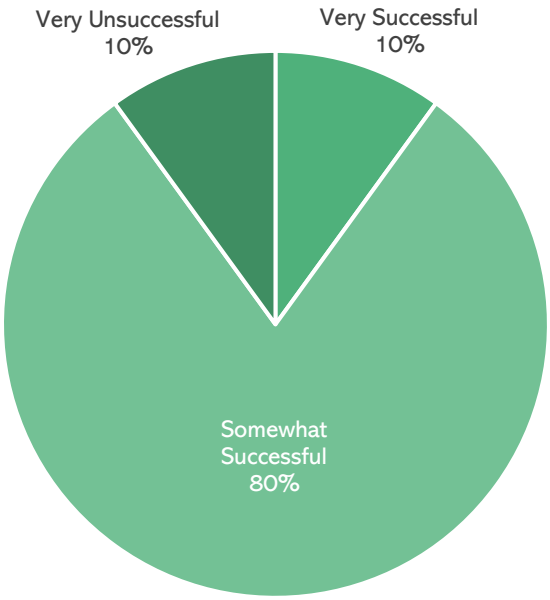


Note. This graph shows (from left to right) the percentage of respondents who reported only positive emotions, then only negative emotions, then both positive and negative emotions. Total n = 32.

Participants practiced more sustainable behaviors after participating in the program. After completing the training, participants were asked to pledge a specific action to reduce their carbon footprint. As can be seen in Figure 6, 90% (9/10) of program participants were somewhat or very successful in implementing their pledged action. Additionally, participants were asked about other everyday behaviors before the program and one week after. The changes in behaviors are summarized in Table 1; however, it should be noted that there were not enough respondents to the one-week follow-up survey to draw any statistically significant conclusions.

Figure 6

Self-Reported Success of Implementing Pledge of Sustainable Action



Note. This figure shows the level of success participants reported in implementing their pledged sustainable action a week after completing the program. Total n = 10.

Table 1

Self-Reported Actions Before and After Program Participation

Self-Reported Actions of Respondents	Responses Before (%) (n=33)	Responses After (%) (n=10)
Consume meat once a week or less	17	30
Always or almost always switch devices off at the plug	47	60
Believe an individual can impact global sustainability	59	90
Have an average shower length of less than 10 minutes	65	90
Always or almost always recycle	100	100

Older participants expressed frustration around sustainability topics. Many of the participants recalled that as children and young adults, their everyday lives were far more sustainable. Walking was a much more common mode of transport, and services like milk deliveries made use of electric vehicles and reusable glass bottles; businesses such as movie theaters even allowed entry in exchange for jam jars and other recyclable items. Participants expressed a general air of frugality, pointing towards the food rations of their youth. Overall, this led to a general disapproval of society's wastefulness, frustratedly stating they were not to blame for the world's regression in sustainability.

5. Needs of Worcestershire County Libraries

In our meeting with the five library managers representing the six libraries we held programs in, we learned the needs of the Worcestershire County libraries and what they foresee in delivering carbon literacy programs of their own. This section opens by discussing some of the libraries' requirements for their program; it then demonstrates the feasibility of libraries delivering the adult and family carbon literacy programs.

Worcestershire County librarians need to have low-cost, easily prepared events on hand that can be delivered by local librarians. From our meeting with the library managers, multiple librarians stressed that they operate on a limited budget and therefore any event they put on must be low-cost and require minimal staffing. Additionally, the library managers emphasized

that they and their staff are busy individuals without much time to dedicate to preparing a program. It was evident from our visits to the libraries that librarians have many different tasks they perform and have minimal downtime during their shifts. One manager summed up that librarians act as "Swiss Army knives," as they are required to fill many roles without necessarily specializing in delivering one program.

Worcestershire Country libraries are better equipped to deliver family sessions than adult sessions. There are two reasons for this. First, as previously mentioned, the librarians are much too busy to take the in-depth training needed to present an hour-long program to adults who may already have extensive prior knowledge of climate-related topics. This barrier is eliminated when presenting to families with young children, as the depth of knowledge needed to deliver a short program to children is much less than that of adults. The other reason that Worcestershire County libraries are better equipped to present to families is the clientele that comes to exiting programs; in our meeting, a library manager pointed out the difficulty in securing adult attendance at the libraries. They noted that since much of their clientele are young children and their guardians, programs targeted towards families with young children are generally well attended.

Recommendations and Conclusions

Working with communities from six different Worcestershire County libraries, we have gained insight on administering carbon literacy programs to different audiences. Based on our observations, we have made the following recommendations to further the development and use of our program.

1. Organizing and Advertising Programs

Participants should be informed of the presentation well in advance. People who are not expecting a presentation are less willing to participate; participants of standalone events were more engaged. *We recommend making all participants aware of the presentation ahead of time,* especially if the event takes place during a club meeting that is unrelated to the environment. If attendance can be secured, host programs as a standalone event.

Programs should have scheduled start and end times rather than being drop-ins. Drop-in sessions do not work well for the lecture presentation format; they require a more conversational approach. While conversations allow for content to be delivered in a more personal way, the amount of content able to be given is much less. *We suggest scheduling a definitive start and end time for programs and keeping to a presentation format with both interactive and discussion aspects.*

Programs should be held in a contained room or area. Open spaces decreased attention for participants and presenters; both activity and noise of other library goers who were not a part of program were distracting. *We propose holding programs in a classroom or meeting room.*

Family session delivery method should be determined by the age of the audience. Children under six had a difficult time paying attention during the lecture portions of the presentation. Especially when older kids were present, the age gap was evident: older kids zoned out, while younger kids were lost. However, young children make up much of the audience of these talks. *We recommend doing activity-only sessions for kids under six,* using it as a starting point to talk to the guardians one-on-one about sustainability.

2. Designing and Delivering Programs

Focus on giving people meaningful actions to reduce their carbon footprint in their everyday lives. People engaged most with content they felt they could control in their everyday lives and least with the content that felt out of their hands. *Our results showed that focusing on actions that participants can personally control has a longer lasting impact,* like food habits (especially using the BBC food calculator) and digital footprints (especially video streaming). Scientific background is also helpful but not necessary to discuss with people who may know more about sustainability already but may be unaware of the specific statistics.

Make use of activities and discussions that engage participants with the material and one another. People who were engaged in our activities noted during discussions that they found the topics interesting. Those who are involved in the conversation will remember the content more than a lecture style format. While it might not allow for the most information to be conveyed, it encourages them to make reasonable, sustainable changes in their lives, whether that be small or large. *We advise making use of activities and discussions, such as the ones provided in Appendices A, B, and C.*

Consider the possible redundancy of content when delivering a presentation to an audience based on their background knowledge of sustainability. Many participants felt it was redundant to be teaching them about sustainability. Individuals who are willing to come to these events are likely to already be involved in fighting climate change. *We support getting a sense of the participants' environmental awareness prior to the program,* so that the program can meet them at their level of understanding. For example, an eco-group may need little to no background information on climate change. Whether that involves omitting portions of the presentation is up to the discretion of the presenter.

When speaking to older groups, acknowledge the sustainable habits they had when they were younger; these were often done out of necessity. Many older participants expressed frustration at society's regression of sustainable practices. *We recommend discussing how they used to live when they were younger, as well as what sort of practices they could re-implement into their everyday lives.*

3. Evaluating Programs

Program directors should follow up with participants between one and three months after program completion. The program potentially had an impact on participant

behaviors, but the sample size was too small and there was not enough time after the program to determine long term effects. *We advise following up with participants between one and three months after the program.*

Provide participants with an option to hold themselves accountable. The survey response rate for the follow-up survey was low, causing our data to not be a reliable representation of the participants' behavioral changes after one week. *Adding the use of an app like the Gaia Challenge* to hold participants accountable to their pledge and give them reminders past the program date might be a good option for lasting change (Mylonas et al., 2023).

4. Resources

As made evident from discussions with librarians and library managers, librarians are extremely busy; they have limited time and a small budget to create programs for their audiences. We recommend having a family "program-in-a-box," where supplies, our notes, and resources are ready to go for librarians to present the program. The family presentation does not require the depth of knowledge needed to present the detailed adult program, which can be time consuming to learn. The family program-in-a-box will allow librarians to have a quick set up time and take less time to learn the content. The family presentation is generic enough to be easily applied or adapted if they choose.

The resources are located in the Appendices, where Appendix A is the family PowerPoint presentation, Appendix B is the adult PowerPoint which can be used for reference if needed for its more in-depth content, and Appendix C is the pinecone hedgehog activity PDF which includes a list of cheap supplies and directions for the activity. This PDF can also be given to participants to repeat the activity at home later. We will also provide a video walkthrough of our program in the form of a blog post on the University of Worcester's Susthingsout page and a link to it in Appendix D (University of Worcester, 2021). Librarians may use their own discretion to modify, omit or add anything they choose to these programs in a box. We encourage librarians to use our guidelines and create a convenient box of our resources for an event for busy librarians to quickly pick up at any time and present to their local community.

Librarians are at the heart of the community; we appreciate the efforts they went through to help us and allow us to aid their mission to provide educational resources to the community. Offering these trainings to an audience that would not normally have access to them will greatly

improve the community's knowledge of carbon literacy; this will be an important step in lowering the carbon footprint of the UK as a whole.

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Appendices

Appendix A: Presentation for Family Version of Carbon Literacy Training

Family_CarbonLiteracyTraining.pptx (Best viewed when downloaded)

Appendix B: Presentation for Adult Version of Carbon Literacy Training

Adult_CarbonLiteracyTraining.pptx (Best viewed when downloaded)

Appendix C: Pinecone Hedgehog Activity for Family Version of Carbon Literacy Training

Family_CarbonLiteracyTraining_HedgehogActivity.pdf

Appendix D: Instructional Video for Delivering Family Version of Carbon Literacy Training

Family_CarbonLiteracyTraining_InstructionalWalkthrough

Appendix E: Carbon Literacy Training Pre-Survey

1. Have you heard of the term “carbon footprint” before?
   - □ Yes, I have heard of it and can define it
   - □ Yes, I have heard of it but do not know what it is
   - □ No, I have never heard of it
   - □ Unsure / Do not know

2. Do you believe one person can help to make the world a more sustainable (Earth-friendly) place?
   - □ Yes
   - □ Maybe
   - □ No
   - □ Unsure / Do not know

3. In a typical week, what is your main mode of transportation?
   - □ Car (individual)
   - □ Car (carpool)
   - □ Motorbike / motorcycle
   - □ Train
   - □ Bus
   - □ Bicycle / kick scooter
   - □ Walk
   - □ Other: _____

4. In a typical week, how often do you switch off electrical devices at the plug?
   - □ Always
   - □ Most of the time
   - □ Sometimes
   - □ Rarely
   - □ Never
   - □ Unsure / Do not know

5. What temperature do you normally set your thermostat to during cool or cold weather?
   - □ Below 18 °C
   - □ 18-19 °C
   - □ 20-21 °C
   - □ 22-23 °C
   - □ Above 23 °C

6. On average, how long is the water running when you take a shower?
   - □ Less than 5 minutes
   - □ 5-9 minutes
   - □ 10-19 minutes
   - □ 20-29 minutes
   - □ 30-60 minutes
   - □ More than 60 minutes

7. While washing your dishes, do you:
   - □ Leave the tap on the whole time
   - □ Turn the tap on to rinse the dishes
   - □ Fill up a bucket in the sink
   - □ Use the dishwasher
   - □ N/A (Not applicable)

8. In a typical week, how often do you use a washing machine?
   - □ Once every two weeks
   - □ Once a week
   - □ Twice a week
   - □ Three or more times a week
   - □ Never
   - □ Unsure / Do not know

9. How often do you use reusable products (shopping bags, water bottles, etc.)?
   - □ Always
   - □ Most of the time
   - □ Sometimes
   - □ Rarely
   - □ Never
   - □ Unsure / Do not know

10. How often do you purchase second-hand items instead of buying new ones?
   - □ Always
   - □ Most of the time
   - □ Sometimes
   - □ Rarely
   - □ Never
   - □ Unsure / Do not know

11. How often do you have broken items repaired instead of buying new ones?
   - □ Always
   - □ Most of the time
   - □ Sometimes
   - □ Rarely
   - □ Never
   - □ Unsure / Do not know

12. How often do you donate unwanted items instead of throwing them away?
   - □ Always
   - □ Most of the time
   - □ Sometimes
   - □ Rarely
   - □ Never
   - □ Unsure / Do not know

13. How often do you recycle?
- □ Always
- □ Most of the time
- □ Sometimes
- □ Rarely
- □ Never
- □ Unsure / Do not know

14. How often do you check the recycling labels on products before deciding which bins they should be disposed of in?
- □ Always
- □ Most of the time
- □ Sometimes
- □ Rarely
- □ Never
- □ Unsure / Do not know

15. In a typical week, how often do you eat meat?
- □ Everyday
- □ Almost everyday
- □ A few times a week
- □ Once a week
- □ Rarely, never
- □ I don't eat meat
- □ Unsure / Do not know

16. About how often do you come to the library?
- □ Two or more times a week
- □ Once a week
- □ Once every two weeks
- □ Once a month
- □ Once every few months
- □ Never
- □ Unsure / Do not know

17. What is your occupation? _____

18. Which library did you attend the training at? _____

Appendix F: Carbon Literacy Training Post-Survey

1. Please share something that you learned during this program:

_____

_____

_____

2. How do you feel after taking this training? Please select all that apply.
   - □ Inspired
   - □ Defeated
   - □ Frustrated
   - □ Pessimistic
   - □ Hopeful
   - □ Motivated
   - □ Saddened
   - □ Empowered
   - □ Other: _____

3. What is a change to your current practices that can be made to reduce your carbon footprint?

_____

_____

_____

4. How likely are you to make and maintain the change from the previous question?
   - □ Very likely
   - □ Somewhat likely
   - □ Somewhat unlikely
   - □ Very unlikely
   - □ N/A (Not applicable)

5. The amount of information covered during this session was:
   - □ Far too little
   - □ Too little
   - □ The right amount
   - □ Too much
   - □ Far too much
   - □ Unsure / Do not know

6. The overall pace (speed) of the training was:
   - □ Far too fast
   - □ Too fast
   - □ Just right
   - □ Too slow
   - □ Far too slow
   - □ Unsure / Do not know

7. How likely are you to recommend this training to your friends?
   - □ Very likely
   - □ Somewhat likely
   - □ Somewhat unlikely
   - □ Very unlikely
   - □ N/A (Not applicable)

8. Which library did you attend the training at? _____

9. (Optional) Would you be willing to respond to a survey by email a week from now? If so, please leave your email below.

_____

10. (Optional) Comments, feedback, area of improvement.

_____

_____

_____

Appendix G: Carbon Literacy Training Follow-up Survey

1. Which library did you attend the training at? _____

2. Have you heard of the term “carbon footprint” before?
   - □ Yes, I have heard of it and can define it
   - □ Yes, I have heard of it but do not know what it is
   - □ No, I have never heard of it
   - □ Unsure / Do not know

3. Do you believe an individual can contribute to global sustainability?
   - □ Yes
   - □ Yes, but significant work will need to be done
   - □ Maybe
   - □ No
   - □ Unsure / Do not know

4. In the past week, what was your main mode of transportation?
   - □ Car (individual)
   - □ Car (car pool)
   - □ Motorbike
   - □ Train
   - □ Bus
   - □ Bicycle/Kick Scooter
   - □ Walk
   - □ Other: _____

5. In the past week, how often did you switch off electrical devices at the plug?
   - □ Always
   - □ Most of the time
   - □ Sometimes
   - □ Rarely
   - □ Never
   - □ Unsure / Do not know

6. On average, in the past week how long was the water running when you took a shower?
   - □ Less than 5 minutes
   - □ 5-9 minutes
   - □ 10-19 minutes
   - □ 20-29 minutes
   - □ 30-60 minutes
   - □ More than 60 minutes

7. In the past week, while washing your dishes, did you:
- □ Leave the tap on the whole time
- □ Turn the tap on to rinse the dishes
- □ Fill up a bucket in the sink
- □ Use the dishwasher
- □ N/A

8. In the past week, how often did you use a washing machine?
- □ Once
- □ Twice
- □ Three or more times
- □ Never
- □ Unsure / Do not know

9. In the past week, how often did you use reusable products (shopping bags, water bottles, etc.)?
- □ Always
- □ Most of the time
- □ Sometimes
- □ Rarely
- □ Never
- □ Unsure / Do not know

10. In the past week, did you purchase second-hand items or have broken items repaired instead of buying a new item?
- □ Always
- □ Most of the time
- □ Sometimes
- □ Rarely
- □ Never
- □ Unsure / Do not know

11. In the past week, did you donate an item instead of throwing it away?
- □ Yes
- □ No
- □ N/A

12. In the past week, how often did you recycle?
- □ Always
- □ Most of the time
- □ Sometimes
- □ Rarely
- □ Never
- □ Unsure / Do not know

13. In the past week, how often did you check the recycling labels on products before deciding which bins they should be disposed of in?

- □ Always
- □ Most of the time
- □ Sometimes
- □ Rarely
- □ Never
- □ Unsure / Do not know

14. In the past week, how often did you eat meat?

- □ Every day
- □ Almost every day
- □ A few times
- □ Once
- □ I didn't eat meat
- □ Unsure / Do not know

15. What is your occupation? _____

16. What change to your practice did you identify could be changed at the end of last week's session?

_____

_____

_____

17. In the past week, how successful have you been at implementing the change identified in the previous question?

- □ Very successful
- □ Somewhat successful
- □ Somewhat unsuccessful
- □ Very unsuccessful
- □ N/A

18. If available, would you be willing to take additional training to gain further understanding?

- □ Yes
- □ Yes but... (please specify in Question 19)
- □ No but... (please specify in Question 19)
- □ No

19. (Optional) Further specifications for Question 18:

_____

_____

Appendix H: Preamble

We are students from Worcester Polytechnic Institute in the United States. We are doing a project with University of Worcester, The Hive, and Manchester Metropolitan University, and our goal is to assist Worcestershire libraries to create, deliver, and evaluate an abbreviated plan to promote carbon literacy and provide possible changes to improve it. We are conducting surveys with training participants to learn more about reactions to the abbreviated training and believe your insights will be extremely useful.

Appendix I: Consent Information (Anonymous)

Your participation in this survey is completely voluntary and you may withdraw or refrain from answering at any time. Your answers will remain anonymous. If you are interested, we will provide you with a copy of our report at the conclusion of the study.

If you have questions, please contact us at gr-wpi-cl-2023@wpi.edu.

Appendix J: Consent Form (Parent(s) of Minor(s))

We are students from Worcester Polytechnic Institute in the United States. We are doing a project with University of Worcester and The Hive, and our goal is to create, deliver, and evaluate abbreviated lesson plans for the Worcestershire libraries to promote carbon literacy. We are conducting interviews with training participants, library staff, and University of Worcester staff to learn more about reactions to the abbreviated training and believe your insights will be extremely useful.

You and your child's participation in this training is completely voluntary and you may withdraw at any time. If you choose to participate in our surveys, you and your child's answers will remain anonymous. You will be asked to stay with your child at all times; all interactions with your child will be done under your supervision, including questions asked about their experience in the program. We anticipate no physical risks to your child. Additionally, we anticipate little to no emotional risks beyond general discomfort surrounding climate change; efforts will be made to redirect any discomfort into action to fight against climate change. You will have complete control over and responsibility for your child and their participation. If we want to use a quote from this interview, we'll ask for your permission.

If you are interested, we will provide you with a copy of our report at the conclusion of the study.

Parent/Guardian Signature: _____ Date: _____

Appendix K: Email Sent for Follow-Up Survey

The following email was sent to the participants who elected to participate in the follow-up survey. Kerri Thornton was listed as both the sender and recipient, with the intended recipients' emails being BCC'd to maintain the privacy of the individuals. The authors' email alias (gr-wpi-cl-2023@wpi.edu) was CC'd. It was emailed exactly seven days after each program, unless this time fell on a Saturday or Sunday; in this case, it was sent out on the following Monday. The bracketed sections in bold were replaced according to the details for the specific program the audience attended.

> Hello!
>
> My name is Kerri Thornton; I was one of the university student presenters at the sustainability talk you attended at [**LIBRARY**]'s [**CLUB**] event on [**DAY OF THE WEEK**], [**DATE**] [**MONTH**]. It was a pleasure meeting you all; we hope you enjoyed the event!
>
> If you're receiving this email, you elected to participate in a short follow-up survey [**HYPERLINK ON 'FOLLOW-UP SURVEY'**] a week after the event. It should take approximately 5 minutes; while it is completely optional, we would greatly appreciate your input! The data we receive will be used to determine what sort of impact the course has had on participants, and your response will remain anonymous. The URL can be found in the hyperlink above or here: https://forms.office.com/r/qzgnst6tpg
>
> Thank you for your time, and I hope you have a lovely rest of your day!
>
> Sincerely,
> Kerri Thornton
> *Delivering Carbon Literacy in Worcestershire Libraries*
> On behalf of herself, Shannon Daly, Thomas Lamar, and Reyna Loycano