An examination into the ways in which museums communicate about and engage audience on climate change and environmental issues on their Facebook platforms

by

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1. Introduction

Climate change is one of the biggest challenges that the world is facing at the moment. The climate change issue has been identified as "one of the most significant and fastest growing threats to people and their heritage worldwide" (García, 2019). It affects many aspects of people's lives and the planet. The social, physical, environmental and economic worlds are all impacted by climate change. Due to human activity, the temperature increases globally, leading to more severe and frequent natural disasters (Jigyasu, 2019). The Ministry for the Environment has identified aspects on which there will be likely impacts of climate change. These include higher temperatures, flooding, water resources, sea-level rise, health, biodiversity, built environment, transport, agriculture, and business and finances (Ministry for the Environment, 2019). The extensive list provides details only for New Zealand. While other countries will likely have similar impacts, other aspects may also be included and might be more severe. Climate change could potentially have a more significant negative impact on developing countries in comparison to developed countries (Dotson et al., 2012). However, some people are still uncertain about the scientific facts about the causes and effects of climate change and the impact of human actions (Parker et al., 2019).

Museums are seen as trusted and reliable sources of information, giving them a unique position to engage and encourage audience participation and action towards climate change (Hamilton & Ronning, 2020; Lackner et al., 2018; Cameron et al., 2013). Museums are, therefore, in a position where they can educate visitors about climate change and inspire a difference in their behaviour and actions. An effort has been made by some museums to inform their visitors about climate change. This effort can be seen through some of the exhibitions which have taken place around the world (Arfvidsson & Follin, 2020; Kwan et al., 2019; Lackner et al., 2018; Cameron et al., 2013; Robin, 2012). The Climate Museum in New York and The Jockey Club Museum of Climate Change in Hong Kong are further examples of entire museums dedicated to climate change. Several studies have also examined how climate change is portrayed in the museum space and how to engage audiences with climate change and environmental issues (McGhie et al., 2020; Parker et al., 2019; McGhie et al., 2018; Swim et al., 2017).

Social media has also become a big part of today's life. Technological changes have had a

significant impact on how information is accessed and how people interact with information, which has also impacted museums themselves. Museums have been utilising social media to reach a wider audience, which has become more evident and integral during the Covid-19 pandemic (Agostino et al., 2020). As the pandemic has forced the world into lockdown, museums had to shut their physical doors, but their virtual doors remained open. There was an increase of activity and engagement online, though events and activist such as hosting online tours, interviews, sharing images and information on cultural heritage and materials, setting quizzes, and even hosting treasure hunts (Agostino et al., 2020).

This research project examined a selection of museums and how they have utilised their Facebook platforms to post about climate change and environmental issues. This project analysed how museums, as cultural heritage institutions with social responsibility, have contributed to the environmental issues and climate change discourse. The analysis further explored the themes and topics surrounding climate change that are the most discussed by the museums. Further analysis investigated whether the response from the audience are negative or positive and commonalities between posts with the most engagement.

2. Literature review

2.1 The importance of communication and engagement on climate change issues

Climate change is the measurable change in the state of the climate, changing the mean and or variability, which can take a decade or longer (García, 2019). Climate change is a threat to humanity and the physical and biological systems which we are all reliant on for survival (Hamilton & Ronning, 2020). The increase in temperature caused by climate change leads to natural disasters. A look at past events will show a clear picture that the way humans are living is not sustainable, and we are depleting our planet of its resources.

It is estimated that from 1988 to 2007, 76% of disasters were related to climate change, which had resulted in 45% of deaths and 79% of economic losses (Jigyasu, 2019). Furthermore, between 2000 and 2007, over 230 million people have been affected annually by disasters, from which 98% were related to climate (Jigyasu, 2019). In 2017 the global damage loss of disaster was $330 billion compared to $130 billion annually between 1987 to 2016 (Foss & Ko, 2019). It is evident that climate change has a physical, environmental,

social and economic impact. The effects of climate change, however, do not seem to be slowing down anytime soon. Scientists have estimated that global emission will reach its peak by the 2050s (Salazar, 2011). Climate change has a tremendous impact globally and will continue to do so, which is why human intervention to reduce temperature increases is integral for a sustainable future (Foss & Ko, 2019). Past disasters have proven to have tremendous impacts due to climate change, and the effects will only become more severe as the climate continues to change.

It is due to these reasons that intervention is needed. To achieve this, communication and engagement with the climate change issue are essential. The discussion of anthropogenic climate change first began in the 1980s (Moser, 2010). There are some who try to persuade people that climate change is not real and use false scientific facts (Moser, 2010). Considering the impacts of human activity on climate change and its severity, it is vital that the importance and implications of climage change are communicated (Moser, 2010). Communicating such issues, however, is not an easy task. Moser (2010) argues that one of the reasons that it could be challenging to communicate the issues of climate change is because of its invisibility, as plainly put, climate change cannot "be seen looking out the window." Although very real, unlike water or air pollution, the naked eye is not capable of seeing greenhouse gas emissions.

Furthermore, research has found that many people are unaware of the causes of climate change and the impact humans do have, however, it is this understanding that will lead to adaptation (Moser 2017). In the US, 87% of scientists argue that climate change is anthropogenic, however, only 50% of the lay population hold the same view (Lackner, 2018). This would suggest that there is a miscommunication or a lack of education and understanding. Indeed, communicating and discussing climate change can be difficult, as climate change is an emotionally charged issue. People can go through a range of emotions such as hopelessness, anger, despair, fear, grief, guilt, worry etc. (Moser 2017). Providing a safe space where people can express these emotions and get to a place of hopefulness and active engagement with the issues is integral as it can lead to empowerment to take action (Moser, 2017).

Taking action on climate change can be achieved through mitigation or through adaptation. Mitigation is concerned with reducing the causes of climate change, while adaptation places the focus on dealing with the consequences of climate change (Moser, 2017).

Mitigation is an intervention to reduce greenhouse gas emission that removes emission and carbon from the atmosphere which can involve actions like forest conservation or clean energy investments (Anderson, 2012). Due to the large amount of greenhouse gas emission already in the atmosphere mitigation is still not able to prevent all aspects of climate change which is why adaptation is needed (Anderson, 2012). Adaptation refers to the focus of decreasing the vulnerability to the effects of climate change. Moser (2017) further argues that "effective communication on adaptation appears as a crucial condition for effective, participatory and democratic planning and decision making for a climate-altered future."

Moser (2017) presents six guidance points on how to communicate the climate change issue and adaptation to climate change effectively. The first is "linking science with lived experience." This provides an opportunity to connect science with real-life experiences. The second aspect focuses on "improving understanding of risk" which empathises the importance of communicating the changes and risks across time, which can be achieved by including statistics, visual aids and stories with which people can connect with and relate. Another critical aspect is "connecting risks to solutions" as if only the risks are communicated without any solutions, this can lead to negative psychological responses such as denial and hopelessness. "Avoiding adaptation jargon" is the following guidance and outlines the importance of avoiding language which is unfamiliar and can be triggering. Under "discovering and jointly deliberating adaptation choices" Moser (2017) states that just as understanding the risks, it is also essential to understand the choices and actions which can be taken towards climate change. The last guidance point is "balancing urgency and efficacy" where the importance of critical awareness of the emotional responses is stated, as climate change can be an emotional issue and the need for a safe space for understanding and compassion to address climate change and the range of emotions which come along with it.

A holistic model involving the head (cognitive), heart (affective), and hands (behavioural) to approach climate change has alose been proposed (Geiger et al., 2017). The head is about understanding climate change and constructively thinking about the issue. The heart is related to the emotional responses to climate change. Studies have suggested that people who are hopeful about climate change tend to stay engaged and find new ways to engage with the issue (Geiger et al., 2017). The hands are voluntary participation with the issue.

Studies have shown that community actions can be the most empowering, which could be due to the fact these actions often result in positive outcomes and a sense of working together towards a goal increasing positive outcomes (Geiger et al., 2017).

2.2 The role of museums in society

Museums' roles are to collect, preserve, and research cultural heritage and use this for educational and leisure purposes for the general public (Pop et al., 2019; Vassiliadis & Belenioti, 2017). The museums' services can be divided into three separate parts, which are accessibility, education, and communication (Vassiliadis & Belenioti, 2017). To provide access, museums must ensure the preservation of the collection. Education and communication are also essential services as, without these, museums are unable to fulfil their roles. Education, public awareness, public participation and access to information are all crucial aspects that are also included in the United Nations Framework Convention on Climate Change (1992) and the Paris agreement (2015) (McGhie et al., 2020).

Within society, museums are views as reliable sources of information (Cameron et al., 2013; Hamilton & Ronning, 2020; Jones et al., 2020). Museums appear to have an integral role within the climate change action as they are a reliable source of information, providing entertainment and education outside of a classroom. Museums are "perceived by audience as impartial 'safe', places that increasingly enable conversations and social interactions" (Cameron et al., 2013).

Museums have reinvented themselves throughout history to adjust and adapt to society's changes and to stay relevant (Lackner et al., 2018; Cameron et al., 2013). Museums need to have social value in order to be relevant and not rendered useless to society. The purpose of a musuem's existence is to service the public, as museum do have a social importance (Fleming, 2016). There has been a call for museums to take action and represent social issues that are of great concern to the world today, and many museums have responded to this call (Cameron et al., 2013; Slazar, 2011). The British Museums Association has published *Museums Change Lives*, a movement in museums to place a focus on social justice (Fleming, 2016). Orloff (2017) argues that museums themself should become social justice agencies. Fleming (2016) further argues that museum should not be natural, and their mission is much larger than just collecting and preserving. Museums should encourage debate and critical thinking leading to inspiration and ideas, which in turn can

change lives. Janes & Grattan (2019) also hold the view that the stance of neutrality in museums is a hindrance and argue that the role of museums in the climate change debate is about social justice. Education is central to museums, and Janes & Grattan (2019) further argue that museums should pose the question, "what sort of education is appropriate and necessary now?" and that it is a museums place to challenge myths and misconceptions.

A study discovered that the public's biggest motivator to address climate change was understanding the causes (Parker et al., 2019). A meta-analysis that looked at 11,944 abstracts published between the years of 1991 to 2011, 97% conducted that human activity is indeed responsible for climate change (Parker et al., 2019). However, Cameron et al. (2013) have argued that because climate change is a highly complex issue, and there is no single answer or fix, museums should reflect this. They further argue that due to the complexity of climate change, museums should not have a single fixed exhibition but representations in a number of different ways through multiple exhibitions where it is applicable. Museums need to communicate rather than prove the science of climate change and give their visitors and audiences the knowledge of how to take part in the climate change solution (Cameron et al., 2013). Salazar (2011) also argues that museums need to communicate and engage, not just inform people about climate change, as only raising awareness of climate change will not combat the issue. Museums, therefore, need to instigate social and behavioural change within people. As museums are seen as a trusted source of information, they have the ability to not only educate but also influence people and their attitudes towards the natural environment and substantiality (Pop et al., 2019).

2.3 Social media and museums

The creation of Web 2.0 has transformed how museums can connect with audiences, allowing people to search for information at any given time and from any location in the world. Technological advances have resulted in communication and interaction to occur through social media (Vassiliadis & Belenioti, 2017; Badell, 2015). Given the current state of the world, due to Covid-19, many museums have also had to place a shift to delivering content online and be 'open' online as their physical doors have had to shut. This event has challenged museums as it changed how they interact with their audience and has placed further significance on social media. It has emphasised the importance that social media has and will continue to have in today's society, as it provides a form of connection and communication.

Social media platforms allow museums to connect with a broader audience (Badell, 2015; Zafiropoulos et al., 2015; Cameron et al., 2013; Fletcher & Lee, 2012). It allows museums to reach a wider audience, outside of the bounds of location and time. The climate change issue is a global issue. Social media provides museums with a worldwide audience to share information and engage with their audiences on issues that matter in the world to make a change. Through social media, museums can provide education and entertainment and encourage engagement and participation while providing and aiding audiences with a learning experience (Vassiliadis & Belenioti, 2017).

User numbers suggest that Facebook is the most popular social networking site and is the one which is used most often by museums (Camarero et al., 2018; Vassiliadis & Belenioti, 2017; Fletcher & Lee, 2012). Facebook allows for communication rather just than passively sharing information (Capriotti & Losada-Díaz, 2018). Facebook is seen as a tool able to offer "conversation and relationships' development" (Vassiliadis & Belenioti, 2017). Facebook is, however, often used to share information about activities, exhibitions or events (Badell, 2015). A review of papers refers to a study that found 60% of posts made on social media sites by museums are reminders, and only 11% of posts are used as a two-way communication to interact with their audience (Vassiliadis & Belenioti, 2017). Through Facebook, however, museums can encourage interaction with their audience through the comments section, not only with the museum itself but with other users. Users can also send direct and private messages to the museum institutions themselves, which can create a personal and trusting relationship with the museums.

Vassiliadis & Belenioti (2017) found that museums do not utilise all the benefits and opportunities from social media. Capriotti & Losada-Díaz, (2018) found that 96% of content on museums Facebook sites is only disseminating information, with 3% of posts calling to opinion and 1% calling to action. This suggests that interaction and engagement are very limited. Furthermore, the study found that museums made a very small percentage within the comments section, and there was little attempt to continue the conversation. Capriotti & Losada-Díaz, (2018), therefore, rightfully so, argue that museums are not engaging or interacting with their audiences. These findings have also been consistent with other studies (Vassiliadis & Belenioti, 2017; Zafiropoulos et al., 2015; Fletcher & Lee, 2012).

3. Research objectives

The objective of this research was to explore in what ways museums, as cultural heritage institutions with social responsibility, have contributed to the climate change discourse via their Facebook platforms. Studies have shown that the most significant focus has been placed on reducing greenhouse gas emissions in response to climate change (Cameron et al., 2013). There are, however, multiple contributors to the increase in greenhouse gas emissions and, therefore, numerous actions that can be taken to combat climate change. One of the most significant contributors, producing up to 29% of all anthropogenic greenhouse gas emission, is the food system (Drew et al., 2020). Thus, the objective was extended to examine if there is a focus on a particular topic within climate change and if it reflects the most significant contributors to climate change. Leading on from this, a further objective was to undersnad and examine the public's response to the representation of climate change by the museums.

4. Research questions

In orderer to be able to reach the objecvies of the research the following two questions helped guide the data collection and analysis.

Q1: What topics do museums posts about on climate change and environmental issues on their Facebook platforms?

Q2: How does the public respond to the museums' presentation of climate change?

5. Research design

Due to the nature of the data that needed to be collected, the data was analysed through a desk research method. Desk research entails collecting data from existing data rather than collecting preliminary data. While the studies from the literature review above have mainly used interviews and surveys to gather their data, this research design was not appropriate for the research questions. A desk reach design was the appropriate approach due to the nature of the research questions, as they are aiming to analyse the themes and topics of climate change and examine the response of the audnece to the portrayal of climate change and environmental issues by the museums.

Yin (2015) defines a case study as "an empirical inquiry that closely examines a contemporary phenomenon (the case) within its real-world context." In this instance, a total

of ten museums were selected as case studies to examine their activities and involvement in climate change issues. The data was collected only once, rather than multiple times, and comparisons were made between the cases and examined the most common themes and topics between the museums. The analysis was performed through content analysis, as this study is interested in the content posted and shared by the museums. Content analysis is the method of collecting data, which is then studied to obtain empirical understanding and knowledge (Bowen, 2009). Although some museums have been participating in the climate change discourse, what aspects they focus on and whether they favour a particular issue is unclear. Moser's (2017) guidelines on how to communicate adaptations and implications of climate change were applied to examine if museums effectively take part in the climate change discourse.

6. Method

6.1 Research sample

A total of ten museums were chosen for this research project. The selected museums, along with their Facebook pages, can be seen in the table below.

Museum	Facebook site
Australian Museum	https://www.facebook.com/australianmuseum
Field Museum	https://www.facebook.com/fieldmuseum/
Liberty Science Centre	https://www.facebook.com/LibertyScienceCenter/
Manchester Museum	https://www.facebook.com/ManchesterMuseum/
Museum Victoria	https://www.facebook.com/museumvictoria/
Natural History Museum	https://www.facebook.com/naturalhistorymuseum/
Powerhouse Museum	https://www.facebook.com/powerhousemuseum/
Science Museum	https://www.facebook.com/sciencemuseumlondon/

Smithsonian Institution	https://www.facebook.com/Smithsonian/
The Climate Museum	https://www.facebook.com/climatemuseum/

Table 1. List of museums and their Facebook platforms examined in this research.

The museums were chosen purposively for the research project. Purposive sampling is when the sampling units are selected on purpose rather than a random selection (Leedy & Ormrod, 2016). This method was chosen as the research project requires cases and collective samples that will give sufficient data to analyse how museums contribute to environmental issues and the climate change discussion. Initially, the top five museums in the world were considered, however, there proved to be very little content available to analyse. Therefore, prior to the final museums' selection, a brief search was done through Google and in the literature for museums that actively engage with climate change issues. No particular attention was paid to whether a museum was public or private, or the museum's size, only that cases were selected which are most suited to answer the research questions. A list was created of 44 museums in total which engage with climate change issues. A brief search was done through the museums' Websites and Facebook platforms. The term 'climate change' was used to gauge how much content is available on the museum's Website and Facebook platform. The museum's mission statement, events, exhibitions, programmes, as well as their messages and activities on their Facebook, were all considered. The museums with the most results were then narrowed down and selected for this project. Although all museums had an official Website, not all museums had a Facebook platform. Due to this, some museums with substantial content on their Websites with other social media platforms such as Instagram, but no Facebook page had to be eliminated.

6.2 Data collection

The data required to be collected for this project was data that already exists and was publicly available. The data was collected from the selected museums' Facebook platforms. As Facebook has a tool that allows a search within the account, key search terms were chosen to locate relevant data for the project. The search terms that were used to collect the data are:

- Climate

- Climate change

- Global warming

- Sustainable

- Sustainability

- Sustainably

- Environment

- Environmental

The various forms and spellings of a word were chosen purposively to ensure that all relevant results are found. The search terms were also purposefully left broad to ensure that all relevant posts and content was retrieved. Once the search was performed using the search terms, only relevant results discussing climate change and environmental issues were used in this study.

Data on the nature of the content about climate change and environmental issues was also collected. The data was then examined to identify if museums tend to focus on a specific element or aspect, such as greenhouse gas emissions by fossil fuels, the agriculture industry, or the impact of plastic on our environment. Data collection began approximately in the last week of March 2021, and the process lasted for three weeks. The data was collected using the search terms from the selected museums and then examined to answer the research questions.

6.3 Data analysis

The data in this research project was analysed through content analysis. Content analysis consists of a "detailed and systematic examination of the contents of a particular body of material for the purpose of identifying patterns, themes, or biases" (Leedy & Ormrod, 2016). Analysing content involves locating, selecting, making sense, and connecting the data in order for it to be organised into themes (Bowen, 2009).

This study took Prior's (2016) approaches to study documentation, in particular Cell 1, which, as stated by Prior (2016) "Approaches that focus almost entirely on what is 'in' the

document." This approach is interested in the content of the document, in this case, the posts, rather than the use of the documents. Cell 1 analyses the documents, and the coding is based on the contents (Prior 2016). Cell 2 was also integrated into this study which is the "'Archaeological' approaches that focus on how document content comes into being" (Prior 2016). Through Cell 2 the examination was placed on the concepts, not just the themes involved. It focused on how the issue of climate change is being presented and framed.

When analysing the data, questions such as "How is this text similar to, or different from, the preceding text" and "What kinds of ideas are mentioned" as suggested by Bowen (2009) were kept in mind in order to see the similarities, differences, and the patters.

The aim here was to describe the content of materials, which was done with the assistance of coding, examining their topics and themes along with their frequency count. Thematic analysis involves identifying patterns from the data, which need to go through a process of category construction and coding in order to understand a phenomenon (Bowen, 2009).

The codes which were developed to analyse the data were data driven, meaning they were derived from the data. The codes began to be developed during the collection stage of the data and the first round of analysing the data. The software NVivo was used to organise the data and codes. Content analysis requires categorising and classifying the object in question by a human judge, which could involve one or more, their subjective opinion, in order to achieve the research goals (Stuart et al., 2017). As this was sole research an inter-rater reliability testing was not possible. The data was, however, analysed twice to ensure consistency to the assigned categories. Table 1 below shows the categories developed for the topics which were covered in the museums' posts about climate change and environmental issues to answers research question one. Table 2 shows the types of comments and engagement of the audience in order to answer research question two.

Category	Description
Solutions	Actions which are already taking place to combat climate change and environmental issues, or suggesting what individuals, politics, laws or focus on inventions to face the issue.

Marketing and promoting	Marketing and promoting events, exhibitions, workshops, or seminar which the museum is hosting and organising on environmental issues and climate change topics.
Impact	The impact that climate change and environmental issues are having.
Calling for action	Calling for actions to be taken against climate change and environmental issues.
Sustainable museum	What the museum itself is doing to be sustainable and how it is taking action.
Personal examples	Sharing individual stories of effects, impacts, and actions of environmental issues and climate change.
Asking for input	Creating a conversation and asking audiences for input around environmental and the climate change issue.
Human	The impacts humans have on the environment and how human actions contribute to climate change.
Fossil fuel, oil, coal	The impacts fossil fuel, oil, and coal have on the environment and how they contribute to climate change.
Plastic	The impact plastic has on the environment and how it affects the earth.
Agriculture	The impact agriculture has on the environment and how it contributes to climate change.

Table.1 Categories for topics of posts.

Category	Description
General and further contribution	General and further contribution to the topic of the post.
Friendship	Tagging friends to bring the post to their attention or having a friendly discussion.
Support and agreement	Supporting, praising, and agreeing with the museum and the museum's involvement with environmental issues and climate change.
Denying climate change	Denying climate change and environmental issues.
Debates	Debates between "believers" and "disbelievers" in climate change and environmental issues.
Sharing links	Sharing links in the comments as further resources on the topics of climate change and environmental issues.

Table.2 Categories for comments.

7. Results

There were a total of 751 posts retrieved from all of the museums' Facebook platforms which were related to environmental issues and climate change. There were a number of posts that were retrieved used the key search terms which were related to prehistoric climate change, such as that of the time of the dinosaurs. These were, however excluded. Table 3 shows the number of posts that were retrieved from each individual museum. Unsurprisingly, the Climate Museum was at the top with 240 posts, and the Powerhouse had

the least number of posts related to environmental issues or climate change with a total of 21 posts.

Museum	Number of posts
The Climate Museum	240
Natural History Museum	117
Australian Museum	96
Manchester Museum	71
Field Museum	60
Science Museum	53
Museum Victoria	36
Smithsonian Institution	31
Liberty Science Centre	26
Powerhouse Museum	21
Total number of posts	751

Table 3. Number of total posts related to climate change and environmental issues per museum.

The data analysis showed that a total of 637 of the 751 of the posts had further links, whether that was events, articles from the museum's website or other sources outside of the museum. Only two posts were text only, with no pictures, videos, links or other forms of media attached. One of these text-only posts came from the Australian Museum, and the other was from the Manchester Museum.

The topic which was most present in the museums' posts on their Facebook platform was ones that had a focus on solutions, which was closely followed by marketing and promoting and the impact of climate change and environmental issues. The lowest number of posts were directly asking audience for input on climate change and environmental

issues, with 17 posts out of the total 751 posts. Chart 1 shows the number of posts that covered each topics surrounding climate change and environmental issues.
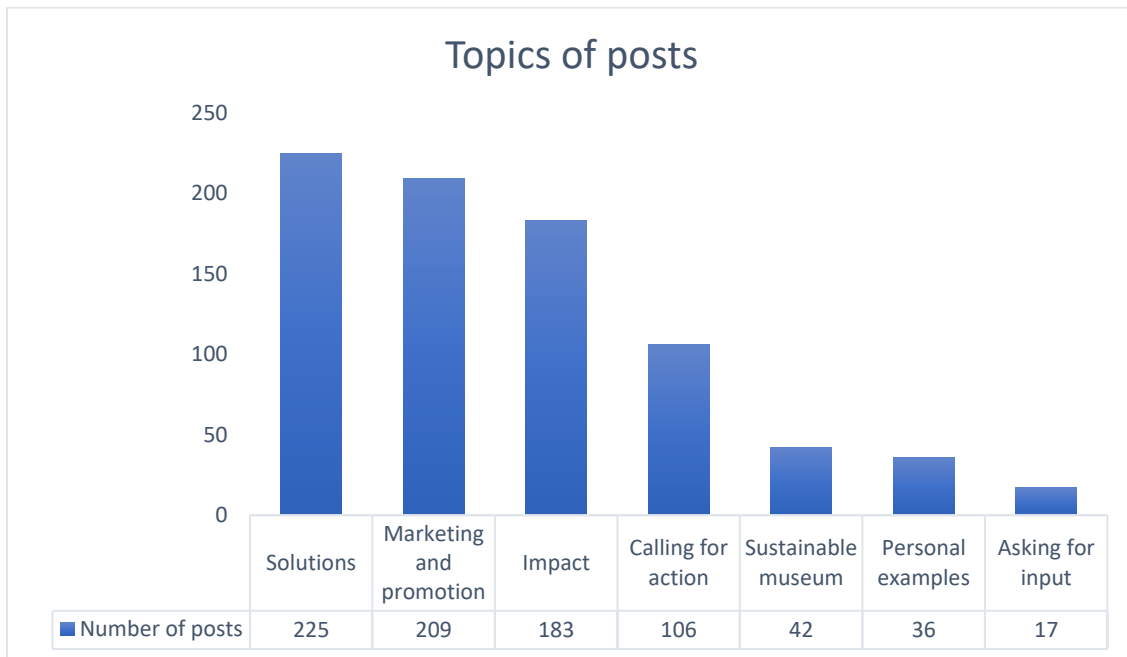

Chart 1. Topics which museums have posted about in relation to environmental issues and climate change on their Facebook platforms.

A separate chart was created for the causes of climate change and environmental issues, as attributed in the museums' Facebook platforms. A total of 46 posts from the 751 attributed humans as contributors and causes of climate change, and the lowest was was agriculture, with only four posts out of 751 discussing the impact agriculture has on the environment and climate change.
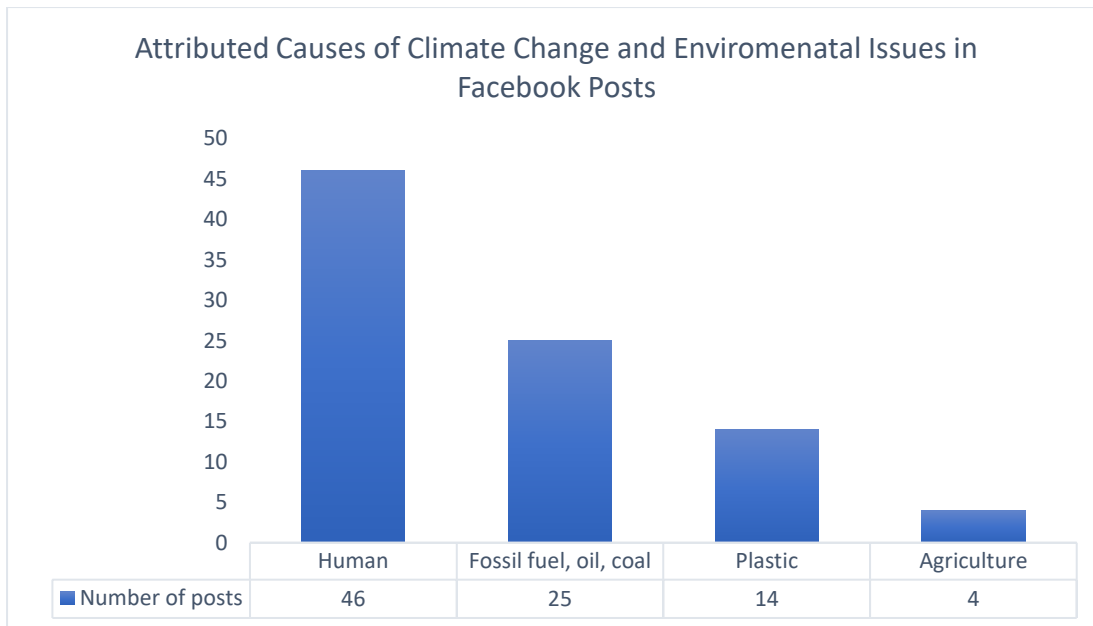
Chart 2. Causes and contributors of climate change and environmental issues in museums' Facebook posts.

Data on the number of likes and follows the museums' Facebook platform had also was collected. Facebook has an option for users to like a page or to follow a page without liking it. By liking a page, a user is showing that they are showing support and when a user chooses to follow a page, the content the page posts will appear in their news feed (Facebook, 2021). When users like a page, they will automatically follow it, unless the user manually changes the settings and unfollows the pages while still liking it. The Smithsonian Institution had the most likes and follows, and the museums with the least likes and follows was the Manchester Museum. Table 4 shows the number of likes and follows the museums' Facebook platform have. This data was collected in order to gauge if there is a correlation between the number of likes and follows the museums' Facebook platform has and the number of responses and engagement from the audience.

Museum	Number of Likes	Number of Follows
Smithsonian Institution	657,182	674,062
Natural History Museum	569,883	613,697
Field Museum	239,097	241,538
Science Museum	224,454	230,547
Liberty Science Centre	137,681	143,358

Australian Museum	84,480	87,828
Powerhouse Museum	63,052	66,389
Museum Victoria	29,301	31,804
The Climate Museum	15,331	15,607
Manchester Museum	12,439	13,196

Table 4. Number of Facebook page likes and follows.

The data for the museums' likes, comments, and shares are summarised in table 5 below.

Museum	Likes			Comments			Shares		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Australian Museum	0	4064	200.397	0	78	17.4546	0	276	44.9667
Smithsonian Institution	35	593	185.448	0	217	10.5294	0	217	57.32
Natural History Museum	24	1540	174.711	0	716	62.3529	0	550	56.5192
Field Museum	4	1144	149.333	0	44	14	0	311	49.4444
The Climate Museum	0	552	113.471	0	42	12.8571	0	441	73.7344
Liberty Science Centre	3	478	75.3	0	55	13.2	0	177	38.6
Science Museum	0	98	28.0833	0	18	5.33333	0	29	9.94444
Museum Victoria	0	137	25.0769	0	10	4.125	0	11	4.9
Manchester Museum	0	27	8.71429	0	6	2.25	0	6	3
Powerhouse Museum	2	33	10.7273	0	33	2	0	5	2

Table 5. Showing the minimum, maximum, and mean number of comments, likes, and shares of posts for each museum.

For research question two, the categories from the audiences' responses are summaries in Chart 3.
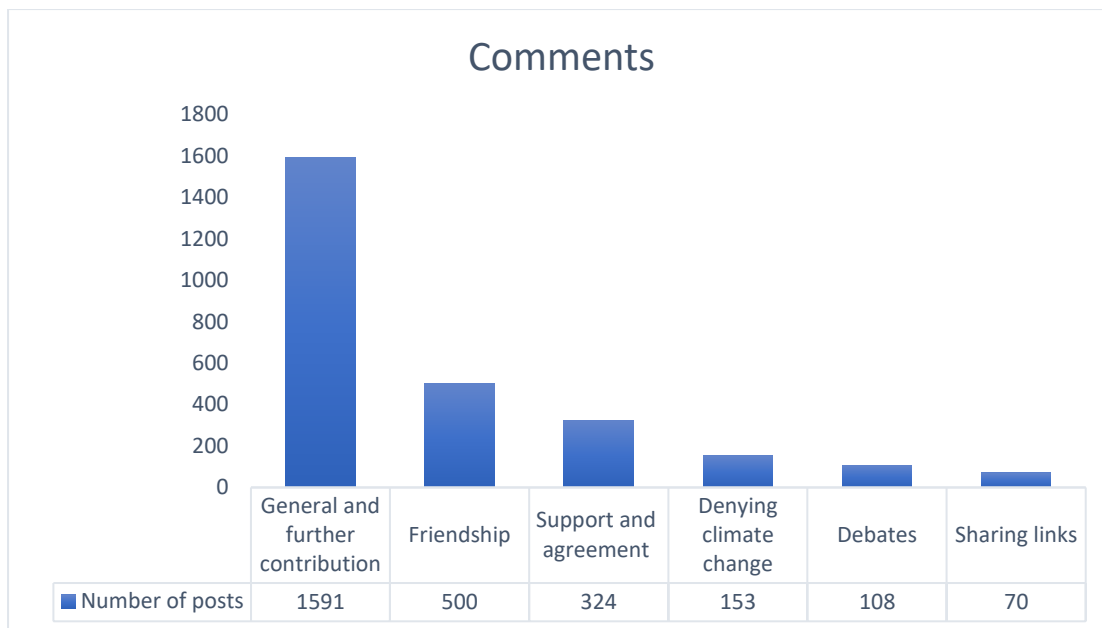
Chart 3. Categories describing the audiences' attitudes and engagement on the museums' Facebook platform posts.

Threads created from a comment by tagging a friend and the friend responding or having debates in the comments were counted as one.

Having posts with zero likes versus thousands of likes is a drastic difference, which led to the extension on research question two, to examine if there is a relationship between the most liked posts from the museums. The top five most liked posts from each of the museums were selected, and their content examined for which were the most common topics.
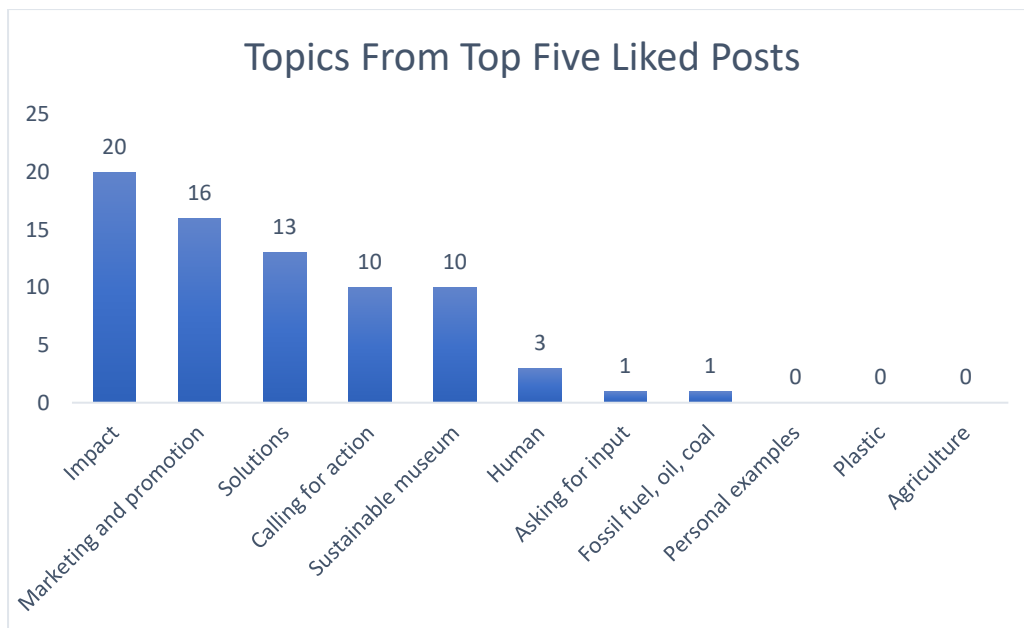
Chart 4. Topics which museums have posted about in relation to environmental issues and climate change from their top five most liked posts on their Facebook platforms.

Out of the 50 top posts, 44 had further links. The other six posts all contained other types of media attached, such as photos of videos.

8. Discussion

Only 114 posts had no further links. The high number of posts that had additional links is encouraging. Some of the links in the posts were from articles from the museum's Webpages while others were links to articles from external sources such as newspapers. Only two posts were text only posts, containing no images, videos, links, or other forms of media. This is encouraging to see as images have been found to be more engaging than just plain text and tend to grab the audience's attention (Stuart et al., 2017). Furthermore, images can further help in communicating a message or meaning. They can provoke emotion and tell us how we should feel. (O'neill, 2013). As only two posts were text only it is evident that museums are implementing this strategy and using various forms of media, such as images, videos, and links which are typically accompanied by images to draw the audience's attention.

8.1 Environmental issues and climate change topics discussed by museums on their Facebook platforms

The most common type of topics which was posted had a focus on solutions, with 225 posts falling into this category. A close second was marketing and promoting events, exhibitions, workshops, or seminars, with a total of 209 posts falling into this category. Impact was the topic that was the third most common, with a total of 183 posts being in this category. There were a total of 106 posts that directly called upon its audience to take action against climate change and environmental issues. This would indicate that museums are still more focused on acting as educational institutions relaying information. A total of 42 covered the topic of how the museums themselves are sustainable and what the museum is doing to take action against climate change and environmental issues. The lowest number of posts asked audiences for their input on environmental issues and climate change, with a total of 17 posts.

There were different tones adapted by the museums when discussing environmental issues and climate change. The Manchester Museum used more hopeful language in comparison to the other museums. An example of this is a post in which they stated, "See the Museum's Climate Control exhibition and explore the idea that we can't change the past but we can change the future, and how we can each make a difference to help create the world of our choice." (Manchester Museum, 2016). The language is closely linked to the last point from Moser's (2017) guidelines on balancing urgency and efficacy as there is a subtle indication of evoking fear by the statement "we can't change the past" but this is immediately followed by a hopeful statement and encouragement of action by stating "but we can change the future." Furthermore, the statement "we can change the future" gives power and accountability directly to the audiences consuming the message, calling and encouraging to take action.

The Manchester Museum also had events hosting movie nights with a focus on climate change which were later followed by a discussion. The only information available from such events was only the description provided by the museum, which made it difficult to gauge what precisely was disused at past events and whether it was focused on the doom and gloom aspects of climate change or if it contained hopeful and inspiring messages.

The Australian Museum had a program with the caption "#CapturingClimateChange" where

it encouraged the audience to submit photos of their experiences, effects, and solutions to climate change. These posts were accompanied by a quote from the photographer and their personal experience with climate change. The Australian Museum contributed 32 posts from a total of 36, which fell into the category of personal examples. This tactic is closely linked to Moser's (2017) linking science with lived experience guideline. Climate change and many of its impacts are often seen as a distant issue (Vu et al., 2021). Sharing a personal example of how individual people or locations, which are familiar to the audience, have been impacted by climate change is a way to bridge the gap between the seemingly distant issue of climate change. Through personal experiences, the audience can see the connection between the scientific facts of the current impact climate change is having.

8.2 Attributed causes of climate change and environmental issues

A total of 89 posts discussed the causes and contributors of climate change and environmental issues. The causes and contributors of climate change, as discussed by the museums, could be further broken down into four categories, which were humans, fossil fuel, oil, and coal, plastic, and agriculture. The latter three categories, of course, are also a result of humans, as humans are the ones which use fossil fuel, oil, coal, plastic and rely on agriculture, however, these categories were explicitly broken down as they were distinctly mentioned as causes and contributors. The category with the largest number of posts was the human category with 46 posts. This is consistent with scientific research, in which 97% of scientist agree that humans do cause climate change (Janes & Grattan, 2019). There were 25 posts discussing fossil fuel, oil, and coal as causes and attributors to climate change and environmental issues. A total of 14 posts discussed plastics' contribution to the environmental issue. Only four posts in total discussed how agriculture caused and contributed to climate change. The Natural History Museum published all four posts.

Human action is a contribution to climate change, and by identifying the contributing actions, they can then be changed. Mitigation requires education centred towards changing lifestyles (Anderson, 2012). Museums do not seem to place the most significant focus on the causes of climate change, as only 89 posts discuss the caucuses and contributors to climate change from a total of 751 posts. Studies have shown that people's biggest motivators to take action towards climate change is understanding the causes (Parker et al., 2019). It has been shown that one of the most significant contributors to all anthropogenic greenhouse gas emission is the food system (Drew et al., 2020). However, there are only a total of four posts

discussing the impact agriculture has on the environment. As climate change is a complex issue, there is no single fix to the issue (Cameron et al., 2013). People learn differently and are motivated by different factors, so why are museums not presenting all the causes and contributors of climate change, especially the impact of animal agriculture as it is one the argest contributors?

8.3 Public's response to museums' representation of climate change and environmental issues

The data analysis showed that the most common types of comments were from the category of general and further contribution. These were comments which further contributed to the topic of the post. The second most common type of comment which was present was friendship, which involved tagging a friend or having friendly discussions. This was followed by comments showing support and agreeing with the museum and praising the museum for its involvement with climate change and environmental issues. There were a total of 153 comments which denied climate change and 108 thread of comments debating climate change. Although these numbers are much lower in comparison with to the general and further contribution comments, it is still an alarmingly high number of people who deny that climate change is real.

Comments denying climate change and having debates about climate change and environmental issues were even present on the Climate Museum. This seemed peculiar due to the fact that a person will need to like or follow the museum's Facebook page in order for their posts to appear on their feed, or of course, go out of their way to specifically visit the museum's Facebook page. Further examination will be needed to understand why it is that some people do not believe in climate change to then, in turn, be able to make them understand the causes and impacts it has on our planet. There is a need to communicate scientific facts to laypeople effectively. There is, however, a level of behavioural change which is needed.

The Australian Museum ranked sixth in number of likes and follows for its Facebook platform, however, it had the highest maximum number of likes on a post. Another exception is the Climate Museum which had the second to the lowest amount of likes and follows on its Facebook platform but scored the highest mean average of shares and ranked fifth in number of likes and comments. This could be due to the fact that the Climate

Museum is specialised and focuses only on climate change, that the audience which it attracts are ones who are passionate about the issues and willing to engage in the subject.

Social issues today are largely discussed and communicated online, which ranges from engaging with digital news to blogs and social media pages. Likes and comments on posts does not necessarily translate to meaningful and genuine engagement (Kent & Taylor, 2021). Numerical data cannot show real listening data. It is more common for Facebook posts which contain a photo with text to be read than those without a photo (Kent & Taylor, 2021). Museums certainly seem to have adapted this strategy as only two posts were only text. Long text posts are furthermore typically uncommon (Kent & Taylor, 2021). Furthermore, it is not enough to only discuss environmental issues and climate change on social medial platforms, as this does not resolve the issue. In order to foster change, a number of different aspects are needed, such as facts, data, meaningful engagement, and access to a variety of expertise (Kent & Taylor, 2021).

Understanding the risks of climate change is an integral aspect of adapting to climate change (Moser, 2017). People are aware of climate change, however, they do not comprehend the reasons for the change, nor do they understand or accept that it is anthropogenic. Understanding and accepting that humans are contributors to climate change is needed to accept and take action for adaption. Communicating climate change needs to be based on the audience and the context to contextualise it in a local setting or within the long term context. An understanding of comprehensive risk awareness is also needed to understand the consequences of climate change. There is also a need to communicate risks with possible solutions that give the audience an awareness of responsibility. When communicating the risks of climate change, the emotional response needs to be at the forefront and not to only focus on the negative as it can lead to feeling overwhelmed and feelings of doom and gloom, instead it should include mitigation and adaptation, which will lead to empowerment (Moser, 2017). This duality needs to be carefully balanced.

Anderson (2012) argues that "there is a clear education agenda in climate change adaptation and mitigation strategies, which require learning new knowledge and skills and changing behaviours in order to reduce vulnerabilities; manage the risks of climate change; change consumption and production patterns; and build adaptive capacity and resilient societies." Critical thinking and problem solving skills are required. Three is a need for a focus on how individual actions can have a positive impact on the outcome. This was not commonly seen

among the posts from the museums.

8.4 Topics from the top five most liked posts

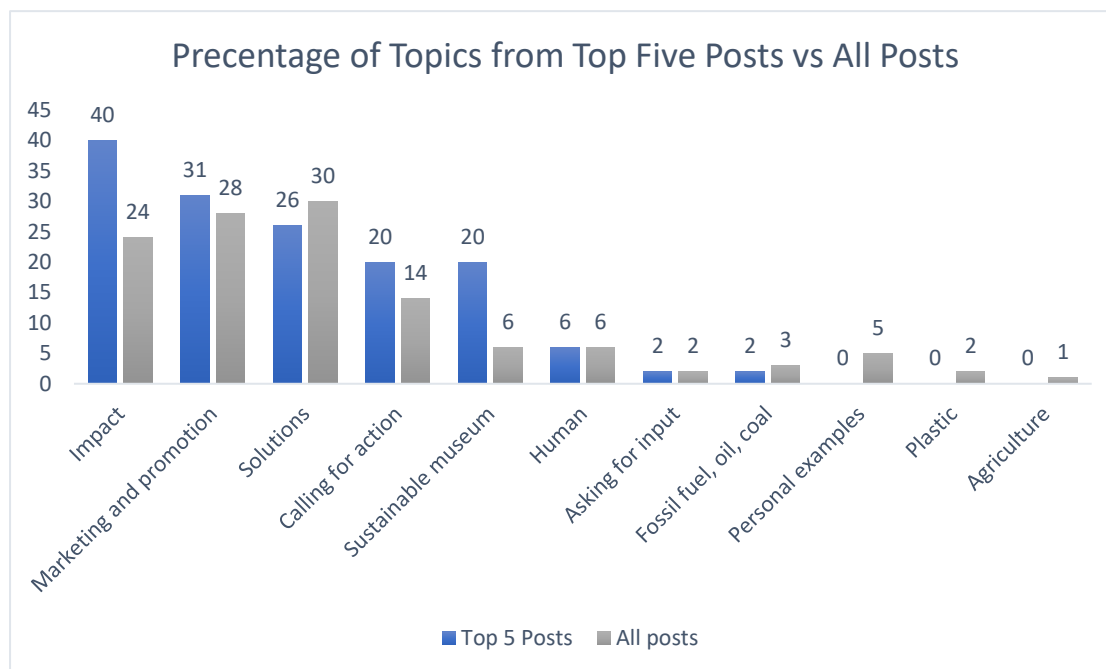**Precentage of Topics from Top Five Posts vs All Posts**

Chart 5. Comparison of percentage of topics from all posts versus top five liked posts from each museum's Facebook platform.

In order to be able to make a comparison between the top five most liked posts from each museum and all of the posts, to further examine if there are topics which the public is most likely to engage with, Chart 5 was created to explore this relationship. The appendix provides the links to the top five most liked posts from each museum, along with which topics categories the posts fall into.

While the most common topic in all the posts was solutions, this seems to have switched places with impact becoming the highest percentage of posts falling into that category and solutions become the third most common topic. The museum's audiences are primarily responding to and engaging with posts that discuss the impacts of climate change and environmental issues. This was closely followed by posts that fall into the category of marketing and promoting. Marketing and promoting seem to be getting the attention of audiences, and that is what they are responding to.

Making comparisons between the museums to draw conclusions on what is the most effective way to communicate climate change and environmental issues proved to be

difficult, as the museums had different numbers of followers and likes, which in most cases resulted in less engagement on their posts, as the content would not reach as wide of an audience.

9. Implication of findings

The findings of this study suggest that there is a balance between discussing the impacts and solutions of climate change, however, there is not a big focus on the causes of climate change, which is this understanding which people need to take action on climate change. Nor is there a big focus on calling for action from audiences and their input on environmental issues and climate change.

10. Limitations

A limitation of this research project was that only data from museums' Facebook pages were analysed. Although museums tend to have a number of different social media platforms, with Instagram, Twitter, and YouTube channels being some of the other most popular social media platforms. Capturing and analysing data on these platforms can, however, be quite challenging. It was due to this that the data collection was limited to only the museums' Facebook pages. Initially, data was collected from the museums' Websites for analysis, however, due to the time restraints and size of the project, only the content from Facebook was used, as Facebook allows to examine the engagement and reactions of the audience.

Another limitation was that only museums from English speaking countries were selected. The Jockey Club Museum of Climate Change in Hong Kong was considered for this research, and although there is an option to set the language to English on their website, there were language barriers on the Facebook platform. While some posts also seem to have an English translation, this was not the case for all of them. Of course, Google Translate did not seem like a reliable tool to be depending on for collecting the necessary data. Therefore, the Jockey Club Museum of Climate Change had to be excluded from this research.

The research project's sample size is another limitation that needs to be acknowledged, as it is a relatively small size of only ten museums. Furthermore, the research and analysis was conducted during a specific timeframe and would be just a snapshot of the phenomenon

during the timeframe of the data collection. It does not account for or represent ant new methods or strategies adapted or any new or continuous conversations on posts.

11. Further research

Further research could examine the funding and why some museums are not talking about climate change at all, and the implication of this.

An analysis could also examine why animal agriculture and its impact on the environment is discussed and other causes such as fossil fuels are favoured. Which could lead to an examination of who has sponsored past climate change exhibits and if the sponsors impact the research.

12. Conclusion

Climate change is one of the most significant issue that people are faced with. It impacts all aspects of human life and the plant which we depend on. It impacts our ecosystem, biodiversity, land use, health, waterways, economy. Climate was described as a shared global heritage in 1988 by Professor David Attard (McGhie, 2020). It is, therefore, a global responsibility. The burden falls on all of our shoulders. For there to be any change, however, there must be an understanding of the climate change issue. Museums are seen as trusted sources of information and provide education and learning outside of a classroom setting. Therefore, museums are in a position to educate and interact with the public about environmental and climate change issues. Technological advances have also changed the way people interact with and access information. Through social media platforms, museums can interact and educate audiences about the environment and climate change.

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Appendix

Top 5 liked posts from each museum and their topics.

Australian Museum

Top 5 liked posts

https://www.facebook.com/australianmuseum/posts/10158351466759527

Posted: 2 March 2021, Likes: 4064

Topics: Further links, Calling for action, Solutions, Marketing and promoting

https://www.facebook.com/australianmuseum/posts/10158317130554527

Posted: 16 February 2021, Likes: 2723

Topics: Further links, Calling for action, Solutions, Marketing and promoting

https://www.facebook.com/australianmuseum/posts/10157252675639527

Posted: 4 February 2020, Likes: 427

Topics: Further links, Calling for action, Sustainable museum

https://www.facebook.com/australianmuseum/photos/a.146682499526/10157352764029527/

Posted: 12 March 2020, Likes: 409

Topics: Impact

https://www.facebook.com/australianmuseum/posts/10156333544819527

Posted: 24 January 2019, Likes: 362

Topics: Further links, Solutions, Sustainable museum

The Climate Museum

Top 5 liked posts

https://www.facebook.com/climatemuseum/posts/1905190166202841

Posted: 20 November 2018, Likes: 552

Topics: Further links, Impact

https://www.facebook.com/climatemuseum/posts/1911543932234131

Posted: 22 November 2018, Likes: 503

Topics: Further links, Impact, Fossil fuel, oil, coal

https://www.facebook.com/climatemuseum/posts/1911547395567118

Posted: 23 November 2018, Likes: 484

Topics: Further links, Solutions

https://www.facebook.com/climatemuseum/posts/1926102570778267

Posted: 4 December 2018, Likes 466

Topics: Further links, Solutions

https://www.facebook.com/climatemuseum/posts/1736073199781206

Posted: 15 July 2018, Likes: 438

Topics: Further links, Impact

Field Museum

Top 5 liked posts

https://www.facebook.com/fieldmuseum/photos/a.10151401123437273/10154404566647273/

Posted: 2 June 2017, Likes: 1144

Topics: Further links, Human, Impact, Calling for action, Sustainable museum

https://www.facebook.com/fieldmuseum/posts/10156186560217273

Posted: 21 September 2019, Likes: 921

Topics: Sustainable museum

https://www.facebook.com/fieldmuseum/posts/10155569440202273

Posted: 7 November 2018, Likes: 560

Topics: Further links, Marketing and promoting

https://www.facebook.com/fieldmuseum/posts/10156909304507273

Posted: 27 June 2020, Likes: 363

Topics: Further links, Solutions

https://www.facebook.com/fieldmuseum/posts/10156364935057273

Posted: 6 December 2019, Likes: 353

Topics: Further links, Impact, Sustainable Museum

Liberty Science Center

Top 5 liked posts

https://www.facebook.com/LibertyScienceCenter/posts/10153648030903124

Posted: 6 March 2016, Likes: 478

Topics: Further links, Solutions

https://www.facebook.com/LibertyScienceCenter/posts/10156744507578124

Posted: 21 April 2019, Likes: 360

Topics: Further links, Marketing and promoting, Impact

https://www.facebook.com/LibertyScienceCenter/photos/a.246784598123/10153801043478124/

Posted: 27 April 2016, Likes: 324

Topics: Marketing and promoting

https://www.facebook.com/LibertyScienceCenter/posts/10153825959818124

Posted: 9 May 2016, Likes: 76

Topics: Further links, Impact

https://www.facebook.com/LibertyScienceCenter/posts/10157311136078124

Posted: 22 November 2019, Likes: 37

Topics: Further links, Marketing and promoting

Manchester Museum

Top 5 liked posts

https://www.facebook.com/ManchesterMuseum/photos/a.10150166506976404/10153658988471404/

Posted: 23 June 2016, Likes: 27

Topics: Further links, Marketing and promoting

https://www.facebook.com/ManchesterMuseum/posts/10156833453471404

Posted: 1 December 2019, Likes: 20

Topics: Solutions, Calling for action

https://www.facebook.com/ManchesterMuseum/posts/10157627677151404

Posted: 28 August 2020, Likes: 15

Topics: Further links, Calling for action, Sustainable museum

https://www.facebook.com/ManchesterMuseum/posts/10153536901711404

Posted: 25 April 2016, Likes: 11

Topics: Further links, Marketing and promoting

https://www.facebook.com/ManchesterMuseum/posts/10151694811086404

Posted: 22 October 2013, Likes 10

Topics: Further links, Marketing and promoting

Natural History Museum

Top 5 liked posts

https://www.facebook.com/naturalhistorymuseum/posts/10156145026361537

Posted: 4 October 2019, Likes: 1540

Topics: Further links, Human, Impact, Calling for action

https://www.facebook.com/naturalhistorymuseum/photos/a.10151974604186537/10153009546561537/

Posted: 14 October 2015, Likes: 996

Topics: Impact

https://www.facebook.com/naturalhistorymuseum/posts/10155769704381537

Posted: 6 April 2019, Likes: 638

Topics: Further links, Impact

https://www.facebook.com/naturalhistorymuseum/posts/10156852265761537

Posted: 20 June 2020, Likes: 400

Topics: Further links, Marketing and promoting

https://www.facebook.com/watch/live/?v=1711856832299203&ref=watch_permalink

Posted: 9 June 2020, Likes: 398

Topics: Impact

Powerhouse Museum

Top 5 liked posts

https://www.facebook.com/powerhousemuseum/posts/10154659396637718

Posted: 21 October 2016, Likes: 33

Topics: Further links, Marketing and promoting

https://www.facebook.com/powerhousemuseum/photos/a.10150394534987718/10157623579987718/

Posted: 30 July 2019, Likes: 18

Topics: Further links, Marketing and promoting

https://www.facebook.com/powerhousemuseum/posts/10157639465992718

Posted: 5 August 2019, Likes 15

Topics: Further links, Calling for action

https://www.facebook.com/powerhousemuseum/posts/10158649247107718

Posted: 21 May 2020, Likes: 11

Topics: Further links, Marketing and promoting

https://www.facebook.com/powerhousemuseum/posts/10157626100717718

Posted: 31 July 2019, Likes: 11

Topics: Further links, Marketing and promoting

Science Museum

Top 5 liked posts

https://www.facebook.com/sciencemuseumlondon/posts/10159413613849676

Posted: 5 February 2020, Likes: 98

Topics: Further links, Solutions, Marketing and promoting

https://www.facebook.com/sciencemuseumlondon/photos/a.112170034675/10151877543959676/

Posted: 15 April 2013, Likes: 81

Topics: Further links, Marketing and promoting

https://www.facebook.com/sciencemuseumlondon/photos/a.112170034675/10160715142609676/

Posted: 15 January 2021, Likes: 73

Topics: Further links, Impact

https://www.facebook.com/sciencemuseumlondon/photos/a.112170034675/10151777999214676/

Posted: 23 February 2013, Likes: 69

Topics: Further links, Solutions

https://www.facebook.com/sciencemuseumlondon/photos/a.112170034675/10151531064724676/

Posted: 11 November 2012, Likes: 51

Topics: Further links, Impact, Asking for input

Smithsonian Institution

Top 5 liked posts

https://www.facebook.com/Smithsonian/posts/10153700484409574

Posted: 21 August 2015, Likes: 593

Topics: Further links, Impact

https://www.facebook.com/Smithsonian/posts/10158541383724574

Posted: 23 April 2020, Likes: 497

Topics: Further links, Solutions

https://www.facebook.com/watch/?v=10153930235744574

Posted: 11 December 2015, Likes: 404

Topics: Further links, Human, Impact, Calling for action

https://www.facebook.com/Smithsonian/posts/10154368183509574

Posted: 26 May 2016, Likes: 372

Topics: Further links, Solutions

https://www.facebook.com/Smithsonian/posts/10153678450714574

Posted: 12 August 2015, Likes 309

Topics: Further links, Impact

Museum Victoria

Top 5 liked posts

https://www.facebook.com/museumvictoria/posts/10154434976171235

Posted: 2 March 2017, Likes: 137

Topics: Further links, Sustainable Museum

https://www.facebook.com/museumvictoria/photos/a.373399576234/10156996747011235/

Posted: 9 January 2020, Likes: 66

Topics: Further links, Impact, Sustainable museum, Calling for action

https://www.facebook.com/museumvictoria/photos/a.373399576234/10157072755241235/

Posted: 4 February 2020, Likes: 63

Topics: Further links, Sustainable museum

https://www.facebook.com/museumvictoria/posts/10155809449496235

Posted: 15 August 2015, Likes: 43

Topics: Further links, Impact, Solutions

https://www.facebook.com/museumvictoria/photos/a.373399576234/10157118542126235/

Posted: 20 February 2020, Likes 39

Topics: Further links, Impact, Sustainable museum