

A SMART MOBILE APPLICATION DESIGNED TO EDUCATE AND AID THE PUBLIC IN COMBATING CLIMATE CHANGE

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ABSTRACT

We aim to tackle the issue of improving the global situation regarding climate change by creating a mobile application named Climerry, which educates its users on recent news related to climate on the home screen. Climerry also features a second tab that allows users to view opportunities to improve the climate change situation in the vicinity by typing in a ZIP code or city name. Some examples of opportunities include beach cleanups and tree-planting sessions. By informing and encouraging the general public to become more involved in the effort to preserve our planet, the negative effects of climate change may be much less significant in the future.

To prove the effectiveness of this application in encouraging the general public to take action against climate change, one experiment was performed to gauge how much knowledge regarding climate change the participants had gained by using the application. Another experiment tested the reliability of the news API used in the application by testing the accuracy of information in each of the selected articles in the featured news section of the application. The result of the experiments indicated that the application is useful when it comes to providing accurate news and educating its users on the topic of climate change.

KEYWORDS

Climate Change, News, Global Warming, Social Issue

1. INTRODUCTION

Climate change is a highly relevant topic that has a global effect on humanity. It is widely acknowledged by the public, and some governments are taking steps toward improving the situation involving global warming. The benefits of addressing climate change early and reducing carbon footprints are mitigating environmental damage done to certain habitats, which preserves the livelihood of animal and plant species and allows those at lower sea levels to continue going about their lives safely. However, the consequences of leaving climate change unchecked include glaciers, rising sea levels, extreme weather patterns, lowered food supplies, and many other changes caused by the overall higher temperatures that can reduce the quality of life for numerous individuals [1].

Making people aware of this topic is crucial to ensuring a better future for generations to come. Erratic weather events and less suitable land to live in are undesirable outcomes. Many believe that ordinary people are powerless against climate change, but the combined efforts of the general public to take small steps against climate change, such as wasting less food and consuming less water and energy, can make a massive difference for the planet over many years. Using public

transport more frequently whenever possible and using fewer plastics are other beneficial actions for the environment. Therefore, the message that climate change can create a plethora of devastating yet preventable consequences to our planet should be spread to as many people as possible, so that more people will be willing to do their part and take action against climate change.

There are currently several mobile applications that are dedicated to educating their users on the subject of climate change. Three particularly notable mobile applications are Commute Greener, MathTappers: Carbon Choices, and Skeptical Science. Commute Greener focuses primarily on gauging the carbon dioxide emissions that are produced during commutes within the United Kingdom. MathTappers: Carbon Choices extends its reach beyond the previously mentioned application by demonstrating how much carbon dioxide is released by doing everyday activities, such as eating and bathing, to provide its users with an understanding of how their activities play a role in climate change. Lastly, Skeptical Science debunks commonly used arguments that attempt to prove that climate change and global warming do not exist, and this application continues to update itself with new research and new counterarguments.

Despite the helpful features that these applications offer, they still have some downsides. Commute Greener and MathTappers: Carbon Choices is only published on the App Store, which excludes those with Android devices. As Android devices have been increasing in popularity over the last few years, a large portion of the potential userbase is being left out of using these two mobile applications. Commute Greener was mainly developed for calculating commutes within the United Kingdom, and those from other countries will be region-restricted from downloading and using the application, which further reduces the userbase of the app. MathTappers: Carbon Choices has a great concept, but lacks many important lifestyle choices that would more accurately gauge the users' personal carbon footprints, such as measuring the environmental impact of using a bus or train as transportation. While Skeptical Science may serve its purpose well when it comes to debunking misinformation regarding climate change, it has an extremely basic layout that can appear almost unprofessional and unappealing. Looking through paragraphs of black text on a white background may not catch the attention of younger generations. Although this application undoubtedly contains massive amounts of knowledge regarding climate change, potential users may skip over this application without the ability of the application to present information related to climate change to them in engaging and exciting ways.

The issue of climate change is tackled using a mobile application called Climerry, which is published on both the App Store and the Google Play Store. Climerry includes a home screen that provides updated climate news and a second screen to participate in activities that directly or indirectly affect climate change. Users will be able to type their city or ZIP code in a search bar to get more localized results. These in-person opportunities include planting trees, picking up trash, and joining city conferences to contribute ideas. For more sparsely populated areas that may lack any in-person opportunities nearby, online opportunities exist as well, such as attending virtual conferences and learning how to more effectively recycle bottles. Climerry is similar to many other climate change applications in that Climerry informs its users of the current global situation regarding climate change. What makes Climerry stand out from many other applications, however, is the ability of the application to provide its users with opportunities to support their communities and create positive change. Rather than being bystanders and watching as the climate change situation becomes more intense, users can play an active role in the efforts to mitigate worldwide damages caused by climate change.

The remainder of the paper is structured in Sections labeled 2 through 6. Section 2 highlights the obstacles that had to be overcome during the development of the mobile application and

performing experiments with the application. Section 3 describes the general implementation of the application as well as details on specific parts of the application. Section 4 provides a thorough description of the experiments that were performed to prove the effectiveness of the application. In section 5, related works are summarized and compared to our current work. Section 6 offers a conclusion in the form of a summary of the application, the application's limitations, and the steps that can be taken in the future to address these limitations.

2. CHALLENGES

There existed several challenges while developing the application, one being the difficulty in finding a reliable method to pinpoint volunteer opportunities specifically to combat climate change around the exact location the user hypothetically inputs. Due to the requirement for extremely localized responses from the application and the need to generate concurrent opportunities during the time the application is used, there needs to be a database that collects all volunteering opportunities surrounding a specific area at a given time. In addition, even through online means, narrowing opportunities to just those involving climate change is a complex process. Moreover, many locations, especially rural areas or thinly-populated communities, do not possess as many of these specific opportunities. Therefore, in addition to a collection of in-person events, the database needed to provide online and virtual opportunities as well, such as lessons on how to properly recycle. With these adjustments in place, the application has become more practical to a larger userbase.

The second challenge while developing the application was the complexity of finding a reliable source of data for the data section of the home page. Because this section needs to update itself consistently, a source of live and accurate data is needed. Many sources, however, including articles, reports, and analyses, all provide static information. One of the only sources available that met this requirement, the Live Climate Scoreboard of Bloomberg [6], possessed an anti-scraping mechanism in its website's AI, preventing it from being used as a reference. The second source found was NASA's Global Climate Change Dashboard [7], which was accessible, but possessed data that was less actively updated. NASA's HTML writings were also more complex, and thus it was difficult to adjust the application's format to scrape the data embedded. Lastly, a system was necessary to consistently perform the scraping action to keep the application up to date without triggering any security systems on the NASA website.

Our final challenge is coming up with experiments that gauge the performance of the application and the effectiveness of the application in educating its users on climate news. To test the performance of the application, a specific feature of the application that plays a crucial role in the application's purpose while being able to be tested for performance would need to be chosen. The news section was selected to be experimented on, and measuring how quickly a freshly published article took to reach the news section of Climerry was the chosen method to test its performance. For testing how effective the application was at educating users on climate, the original idea was to have the participants rate their extent of knowledge of climate news after using the application for a set period. However, everyone has different backgrounds and different levels of knowledge in certain areas prior to using the application. Therefore, an updated experiment was implemented that asked the participants to score their knowledge level in climate news before using Climerry as well.

3. METHODOLOGY

3.1. Solution Overview

The application is currently composed of two main pages: the home page and the volunteering page. The landing page includes a frequently updated news section, which gives people an easy, fast, and accessible source of information regarding climate change. All the news in the application is retrieved from one API. This serves to inform people more about the current status of climate change and the events surrounding this subject. The home page also includes a statistics page that uses quantitative data live from NASA to portray the worsening severity of the global situation, hopefully convincing people to heed the warnings of climate change. The user can press the three bars in the top left of the screen to open a slider, then press the second tab in the slider to transfer to a page for volunteering. On the volunteering page, users can search for local volunteering opportunities to combat change. For the application to inform the users of local volunteering opportunities, the application requires the user to input a city name or a ZIP code in a text box at the top of the screen. Based on this information, the application returns opportunities that are within the area which are retrieved from a database, meaning that users can contribute without having to travel unnecessarily long distances. This in turn leads to more community involvement tackling the issue, thus incorporating people into the effort at a faster rate. By experiencing a volunteering event, people are more passionate and aware of the situation.

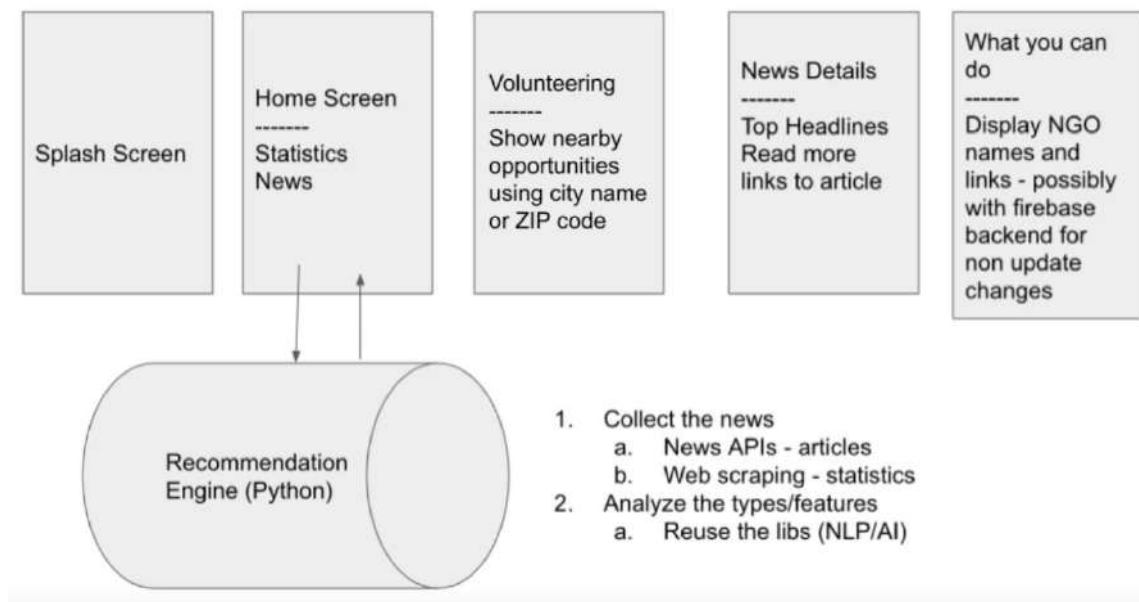


Figure 1. Frontend and Backend Design

3.2. Implementation

Flutter is used as the front end of the application to provide a clean and intuitive user interface, while Python acts as the back end. Since Python and Flutter are different programming languages, a framework called Flask is used to connect the two different sections of code together. In the Python code, several methods are used to provide the functionality to the application, and they are routed with the help of Flask to return the information to Flutter.

The application is composed of two main screens, which are the home screen and the volunteer screen. As shown in the left of Figure 2, the home screen has a news section, which is managed with the help of Python. Using an API key, a News API Client generates every kind of news with a query that contains the words “climate”, “change”, “mitigation”, “conference”, and “IPCC” inside of it. From the dictionary object that is generated, only the articles are selected. The articles are then converted into a JSON file and sent to Flutter to display. Within the home screen, a statistics page is also shown that informs the user about the current carbon dioxide level, global temperature anomaly, arctic sea ice minimum extent, ice sheets, sea level, and ocean warming level. To implement this into the application, the information from the official NASA climate website was scraped in Python using HTTP get requests with the website links. Then, each HTML would be parsed using BeautifulSoup. To individually pick out the desired statistic from each link, the HTML elements with the class tag that contained the statistic were collected. Then, the first element of its contents attribute was stripped, leaving only the number left. From here, the relevant numbers are added to a dictionary. The dictionary of statistics is delivered as a JSON file back to Flutter, where the statistics can be displayed in the application.

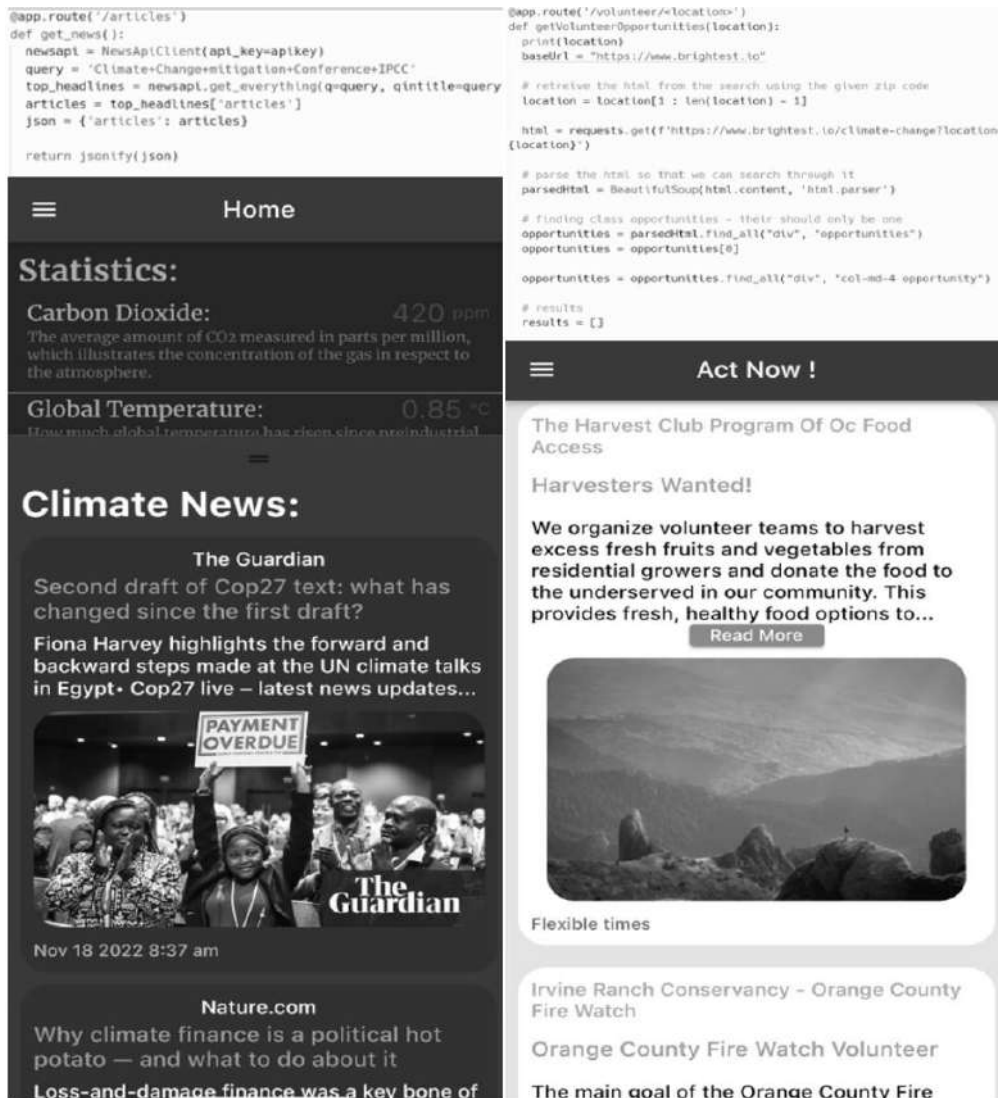


Figure 2. Screenshots of application and corresponding code

Shown in the right of Figure 2 is the volunteer screen, which features a search bar that prompts the user with the message “Search by City State or Zip”. When the user properly inputs their location information, the application will display local, nearby opportunities that the user can partake in. This is achieved by making an HTML get request for Brightest’s website. Brightest is a company that is dedicated to providing sustainable solutions. The HTML is parsed and all HTML elements with the desired div tag are retrieved. The HTML elements are then processed and passed back to Flutter to be displayed. However, this will not be instantaneous, and the user will have to wait before receiving these opportunities. To indicate to the user that the application is not frozen or faulty and the opportunities are still being loaded in, the Flutter code uses a boolean variable called `is Loading` to keep track of when a process is happening. If the opportunities are processing, the `is Loading` variable’s value is true. Because `is Loading` is set to true, the volunteering screen will display a circular progress indicator object slightly below the other elements that are currently on the screen (Reference Figure 3).

4. RESULTS

4.1. Experiment 1

To evaluate whether the application is effective at educating the public on climate change, a survey will be conducted among all participants to test how much knowledge the participants believe they have gained from using this application. Each participant will rate what they believe their current level of knowledge is regarding current climate news from one to ten, then they will scroll through the current climate news section of the application’s home screen for ten minutes. Finally, they will rate their current level of knowledge regarding climate change again and leave any optional feedback they have in a free-response section. By recording scores from both before and after, the current climate news can be tested for whether the information within the news is helpful and is not too basic or common among the general public. Because there will be 32 participants in total, the sample size will be large enough to account for any variability.

Table 1. Climate Awareness (Before vs. After using Climerry)

Participant	Knowledge Before Using Climerry	Knowledge After Using Climerry
1	7	8
2	5	5
3	3	5
4	1	6
5	4	4
6	3	5
7	1	4
8	6	9
9	8	8
10	5	6
11	4	6
12	3	7
13	5	6
14	7	7
15	3	6
16	4	4
17	5	6
18	7	9
19	5	10
20	3	5
21	2	5
22	5	8
23	6	8
24	5	8
25	5	7
26	4	7
27	4	8
28	5	5
29	6	6
30	5	7
31	6	7
32	6	8
Average	4.625	6.5625

Self-Reported Knowledge of Current Climate News



Figure 3. Climate Awareness (Before vs. After using Climerry)

Among all of the participants, the self-reported knowledge level of current climate news after using Climerry was either greater than or equal to the self-reported knowledge level of current climate news before using Climerry. The knowledge levels before using Climerry ranged from 1 to 8, and the knowledge levels after using Climerry ranged from 4 to 10. Furthermore, according to the data collected from the participants, the self-reported knowledge of current climate change had a significant average improvement of almost 2 points after using Climerry. The majority of the improvements were somewhat moderate, but the largest improvement was 5 points, in which a participant went from having a self-reported knowledge level of 1 to a self-reported knowledge level of 6. In the free-response sections, participants generally admitted that they would likely have never seen many of the articles that they did from Climerry, and they would be willing to keep the application installed and occasionally check the application for future climate news.

4.2. Experiment 2

To combat the possible issue of the application spreading misinformation through faulty news articles, the application is experimented on for its news articles' reliability and accuracy of information related to climate change. The application will be opened and the articles that appear on the will be scrolled through. Articles within the application will be selected at random, and two other articles on each article topic will be manually read through and compared with the original article displayed from the application. If the original article's information seems to match the information of the others, the article will be marked as accurate. However, if the original article states information that directly contradicts the information of both related articles, the article will be marked as not accurate instead. This experiment's design was implemented because it is significantly less likely for both related articles to be false than it is for the original article to be false. Twenty articles will be used as the sample size in the experiment, which is enough to mitigate the effects of variability. The results will be recorded in a table.

Table 2. Accuracy of News Sources

Article	Source	Accuracy of Information
1	24/7 Wall St.	Accurate
2	Business Wire	Accurate
3	Yahoo Entertainment	Accurate
4	Desmog.com	Accurate
5	Archinet	Accurate
6	AllAfrica	Accurate
7	Thechronicle	Accurate
8	The Times of Israel	Accurate
9	New York Times	Accurate
10	Otago Daily Times	Accurate
11	Phys.org	Accurate
12	24/7 Wall St.	Accurate
13	Forbes	Accurate
14	Business Wire	Accurate
15	Yahoo Entertainment	Accurate
16	Archinect	Not Accurate
17	The Chronicle	Accurate
18	Otago Daily Times	Accurate
19	Plos.org	Accurate
20	Euronews	Accurate

Based on the results of the experiment, an overwhelming majority of the news articles selected by the application contains accurate information. Nineteen out of twenty tested articles were compared to other articles on the same topic and were found to have consistent information, which indicates that approximately 95% of future articles selected by the application are trustworthy. Only one article that was labeled as inaccurate had a discrepancy between two other articles on a statistic, but the rest of the information inside the article appeared to be accurate when compared to the related articles. One possible reason why this percentage of accuracy is so high is that the API that selects the articles for the news section only chooses from trustworthy sources. Another possible reason is that articles on a similar topic may reference each other, and the information from the articles would be very similar as a result.

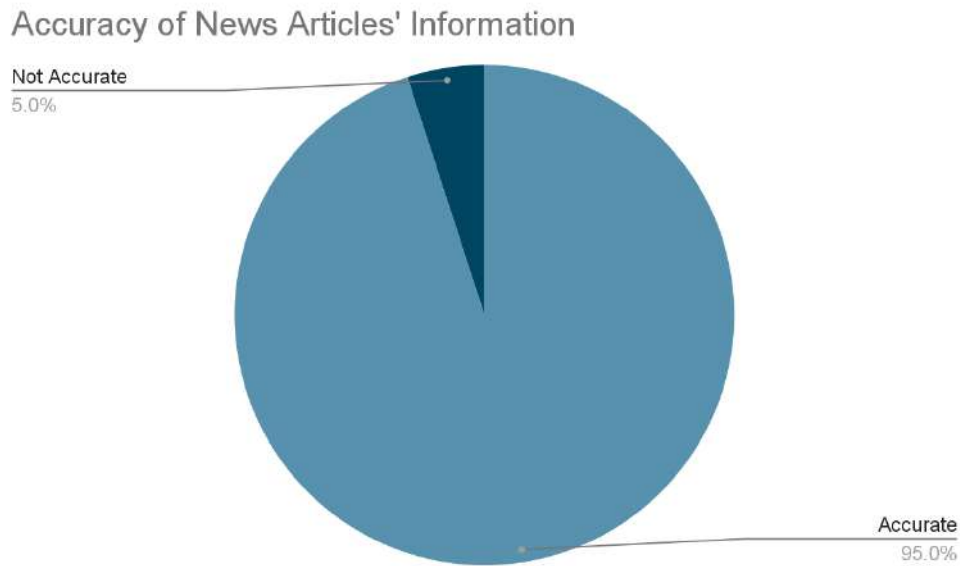


Figure 4. News Source Accuracy

4.3. Analysis

The results from the first experiment indicate that the general public can greatly expand their knowledge involving current climate change news by using this mobile application. Since the majority of participants reported an increase in their self-measured level of knowledge regarding climate change, the application appears to be very effective at educating the general public. The application has been proven to serve its purpose well, which will potentially result in more long-time users of the application.

The second experiment's results reveal that the articles that are displayed in the news section of the application are generally very accurate and contain information that remains consistent across other related articles. Therefore, when users gather information regarding current climate change by perusing through the news section of the application, they can feel fairly confident that they are consuming accurate news. Overall, the two experiments prove that users of Climerry can be constantly updated with relevant and true climate change information.

5. RELATED WORKS

A study has been conducted on promoting behavior that helps the environment through the implementation of game design principles. The study has found that games and other applications that incorporate game design principles are more effective than other methods, although it cannot provide a conclusive explanation behind this [2]. This study is similar to our work in the sense that both deal with the primary focus of climate change and the utilization of applications. However, the study also dives into the effectiveness of gamification when it comes to behavioral changes in people. On the other hand, our work provides a larger focus on improving the situation with climate change itself.

Another work describes methods to reduce the effects of climate change and the effectiveness of each method, ranging from the addition of nutrients in the ocean to promote biological activity and absorb more carbon dioxide to the injection of reflective aerosol particles into the atmosphere

to reduce global temperatures. The work ends by providing a call to action for how incentives and strong encouragement from governments can improve the situation regarding climate change [3]. This work shares a major similarity with our work, which is the strong emphasis on climate change. While this related work places a stronger focus on possible strategies to tackle climate change, our work incorporates the spreading of news regarding climate change and the possible opportunities to take part in improving the situation regarding climate change.

A third work highlights those who are skeptical about the existence of climate change and utilize the media to further their movement of discrediting science. The collective new service community has been demonstrated to be a dominating source of news pertaining to climate science, and the attack on climate science bears a striking resemblance to past attacks on other fields of science, such as the pesticide and chemical industries [4]. This work is incredibly similar to our work since both of the works heavily emphasize the general public's knowledge regarding climate change. Our work goes more into spreading information, while the related work explores the spread of misinformation.

6. CONCLUSIONS

Our mobile application, Climerry, aims to prevent unnecessary damage to the environment by spreading knowledge of the global situation regarding climate change and encouraging others to take action. To achieve these goals, Climerry contains a current news section on its home screen that is related to climate change, which updates its users on the latest information. Climerry also offers opportunities for its users to actively take part in the effort against climate change by inputting a ZIP code or city name to narrow down the nearest ones.

To test how effective the application is at educating its users and outputting relevant and popular articles to the users, two experiments were performed. The first experiment involved gathering thirty-two participants to label their current knowledge of climate change from one to ten, use the application for ten minutes, then label their knowledge of climate change again using the same scale. The second experiment involved retrieving the articles in the news section of the application and comparing the information in these articles to the information in other articles on the same topic to test the application's ability to output reliable news. According to the results of the experiments, the news section is incredibly effective at helping users gather recent and accurate information regarding climate change. Participants in the experiments generally had a significant self-reported increase in their current knowledge of climate change, and tests comparing articles selected by the application to related articles indicate that the information from the selected articles is very consistent.

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