

ANALYSIS

Open Access



Australia's university Generation Z and its concerns about climate change

Rodrigo Bardales Salguero¹, Diana Bogueva¹ and Dora Marinova^{1*}

Abstract

Despite scientific evidence about the imminent threat of climate change, people and governments around the world are slow in taking sufficient action. Against these bleak outlooks, Generation Z (Gen Z) born 1995–2010 will inherit the consequences of prolonged inaction. This research delves into the climate change concerns of Australia's university Gen Z. A representative survey of 446 Australian university students conducted between September 2021 and April 2022 revealed that climate change is the top environmental concern for Gen Z with 81% of these young people being significantly concerned and many experiencing serious climate anxiety. Despite this pervasive concern, 65% of Australia's university Gen Z is not engaged in traditional climate activism; however, these young people are using technology to voice their concerns. As the future decision-makers of the world, it is crucial for Gen Z to accelerate climate action in all of its forms, including engaging with scientific knowledge and other generations to shape policies and safeguard a liveable planet for all.

Keywords Generation Z, Gen Z, Climate activism, Climate anxiety, Sustainability, Sustainable Development Goals (SDGs)

Introduction

There is a wide scientific consensus that climate change poses a tremendous risk to human civilization. According to the United Nations' Intergovernmental Panel on Climate Change (IPCC) [1], it is unequivocal that human activities have propelled and continue to intensify the global warming of the planet due to the burning of fossil fuels and release of greenhouse gas emissions (GHG). As a result, "each of the last four decades has been successively warmer than any decade that preceded it since 1850" ([1], 5). This is resulting in more severe climate events characterised with frequent bushfires, extreme heatwaves, devastating storms, floods and droughts. Consequently, scientists are warning governments around the world that a concerted effort must be taken

to limit warming at 1.5 °C above pre-industrial levels to prevent these events becoming more dangerous and catastrophic [1]. All successive IPCC publications are sending the same message of urgency and warning about tipping irreversible points, with climate change now being described as "global boiling" and humanity having "opened the gates to hell" [2].

The IPCC ([3], 35) emphasises the urgent need for climate action stressing the existential threat posed by reaching tipping points to human well-being, planetary health and global economies. The 2023 World Economic Forum's Global Risks Report [4] identifies "Failure to Mitigate Climate Change" and "Failure on Climate Change-Adaptation" as the top two global threats, highlighting the risk from reliance on carbon-intensive sectors.

Given this uneasy reality, immediate action to respond to the climate crisis is expected from governments, industries, civil society and individuals. Despite some progress made at the 28th meeting of the Conference of the Parties (COP28) to the United Nations Convention on Climate Change (UNFCCC) about

*Correspondence:

Dora Marinova

D.Marinova@curtin.edu.au

¹ Curtin University, Perth, Australia



© The Author(s) 2024. **Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

transitioning away from fossil fuels and moving to sustainable agriculture [5], current climate policies worldwide fall short of the necessary strength to effectively tackle the escalating climate crisis [6]. The interconnectedness between climate change, biodiversity, the health of ecosystems and human society is also widely recognised [6] with the adverse impacts of human-induced climate change continuing to intensify and causing widespread damages and losses.

Despite the consensus in the scientific community over the reality and significance of anthropogenically caused climate change and the overwhelming amount of evidence that the planet is warming, many people and organisations across the world still do not support efforts to mitigate global GHG emissions. In some cases, many still dismiss completely the climate science and its warnings. This is happening in different countries and at various levels of society, including world leaders and government representatives. For example, global environmental problems are increasingly contested by well-known sceptical of climate science world leaders like the former United States' president Donald Trump, who has claimed that climate change is a hoax [7], and another strong climate change denialist the Australian ex-prime minister Scott Morrison [8]. This has an impact on finding global climate solutions, creating controversy around climate science and delaying action to urgently address climate change.

Although in 2015, 196 countries worldwide pledged to restrict global warming to well below 2 °C, preferably 1.5 °C, to mitigate the devastating effects of climate change under the Paris Agreement [9], the IPCC [6, 10] reported that despite progress, rising temperatures persist due to a lack of political determination. Consequently, the IPCC [10] unequivocally declared that the world has a limited window until 2025 to peak global emissions and must halve them by 2030 to have any hope of limiting global warming to 1.5 °C. A global agreement to accelerate climate action was achieved at COP28 but its future depends on implementation and effective engagement across the globe.

People are becoming increasingly aware of the dangers that climate change poses to human health and well-being [11]. This vital recognition highlights the various ways climate change affects humanity beyond just physical health. When people directly experience extreme events, such as major storms, droughts or wildfires, it can seriously affect their mental state and can cause post-traumatic stress disorders. This understanding stresses the urgency of addressing climate change not just as an environmental issue, but also as a complex problem that affects every aspect of human lives. Climate anxiety stems from profound concern

about climate change and its far-reaching consequences for both the natural environment and human life [12]. Such distress can manifest as disturbing thoughts or overwhelming feelings of concern regarding forthcoming future climate disasters and the continuing fate of humanity and the world. It can also translate into fear, insecurity, paralysis and inaction [12] as well as feelings of anger, exhaustion, powerlessness and sadness [13]. Addressing the challenges of climate change and their impacts on future generations requires a holistic approach emphasising the need for comprehensive strategies to mitigate any adverse effects. Avoiding climate anxiety highlights the pressing need for action and a collective search for sustainability solutions to alleviate these concerns and secure a stable future for generations to come.

Younger people are particularly affected by climate change prospects despite having contributed very little to the current situation [14]. This research focuses on Generation Z (Gen Z), namely people born during the period 1995–2010, in exploring these young people's crucial role in addressing climate change. There is evidence that Gen Z overwhelmingly believes that climate change is anthropogenic. The share of these Australian young people who consider that humans are responsible for climate change is 96% [15]. However, what is not clear is how Gen Z deals with the environmental challenges it faces. The question this study addresses is: How is Australia's university Gen Z reacting to climate change? It has four objectives related to Australia's university Gen Z, namely: (1) assess concern about climate change amongst other environmental factors, (2) analyse the level of worry about climate change; (3) estimate the level of social change behaviours of these young people and (4) elucidate their preferred ways of communication.

Comprising 30% of the world population, Gen Z represents the youngest purchasing and decision-making group. In Australia, Gen Z comprises 18.2% (or 4.6 million) of the country's 25 million population [16] and many of its members are enrolled in tertiary studies. The share of university Gen Z students is estimated at 14% of this Australian population cohort [17]. Besides offering better job prospects, study at university exposes young people to the latest advances in science and technology giving them access to up-to-date knowledge and skills development. According to Times Higher Education [18], university students are a distinctive section of any society which has positive attitude towards studying, is capable of thinking and working independently and in groups, shares a passion for the subject of study, has an inquiring mind and can persevere with challenging tasks. They are a forward-looking progressive group, persistent in their efforts to build new career

opportunities. According to McCrindle [19] in comparison with the previous generations, Gen Z represents the most digitally connected, globally engaged and formally educated generation in history.

This study investigates how members of Australia's university Gen Z are reacting to the climate crisis analysing their concerns and social change behaviours towards taking action. It provides insights about this generational cohort, its perspectives and concerns that can serve as a proxy for its level of climate-related anxiety [11]. As Gen Z is expected to bear the impact of the worst climate-change effects, understanding these young people's concerns is pivotal in shaping climate policy. We use the term "concern" as the main interest of the survey was about the young people's opinion rather than the full spectrum of how individuals perceive, recognise and experience the world, and specifically, climate change [20]. These concerns are expression of worry and perceived risks regarding climate change [21]. The level of anxiety per se was not assessed but concerns provide a good understanding of young people's reactions to the desire for survival, including avoiding injuries and harm. Attitudes are a related concept, however, they form directly as a result from beliefs, values, feelings and experiences, including from learning [22]. By contrast, concerns and perceptions are a more intuitive, sensory and subjective reaction to the world and usually they shape attitudes. In this study, we are particularly interested in concerns as they form the basis of future responses to climate change.

Following clarification why considering university Gen Z is imperative for climate change, the paper explains the study's methodology. It then presents and discusses the obtained results followed by recommendations and outlining of the limitations of the study. The main conclusion is that despite high concern about climate change, Australian university students are yet to pro-actively engage in mainstream climate actions.

Why Australia's university Generation Z?

Encompassing individuals born between 1995 and 2010, Gen Z stands at the crossroads of an era marked by profound shifts and events. Shaped by the digital age, these young people are experiencing global warming, economic uncertainties, the COVID-19 pandemic and geopolitical uncertainties, finding themselves at the forefront of a polycrisis with many threatening events happening at the same time [23]. In fact, Gen Z has to navigate a world that is drastically different from that of their predecessors. Positioned as the second-youngest generation, situated between the Millennials (born 1981–1994) and Generation Alpha (born after 2010), Gen Z's worldview and behaviours have been intricately moulded by their

unique digital native, tech-savvy, independent thinkers' experiences and also their socially conscious relationships with their societal, economic, environmental and technological surroundings.

Growing up during concerns about the planet's changing climate, pandemic-induced restrictions and economic uncertainties, Gen Z has cultivated a distinct perspective on life. Their developing years were influenced by the pervasive presence of the internet and social media, making them the first "digital natives" – a generation seamlessly integrated into the digital fabric of daily life. This diverse cohort spans a wide spectrum: from the oldest Gen Zs who are already juggling jobs and mortgages to the youngest, yet to step fully into their teenage years and later into the Australian workforce [24].

Crucially, Gen Z's impact is not narrowed and restricted within national borders. Being digital natives, they are persistently online and their connectivity is a global phenomenon. They are politically and socially active, advocating for causes aligned with their principled beliefs, striving to transform the world, mitigate the worsening of climate change, and advance greater fairness and equity for all [25]. Gen Z stands out as a generation deeply committed to purpose and accountability, setting a distinct tone in comparison to their predecessors. Their voices reflect a keen awareness of social inequalities, emphasising the need to broaden opportunities for those from diverse and underrepresented backgrounds. Additionally, their focus on rigorous sustainable and green practices underscores a proactive approach to addressing environmental challenges, showcasing a forward-thinking mindset that prioritises both social justice and environmental responsibility.

Globally, Gen Z is rapidly expanding as a share of all people on this planet and it is estimated that it will represent approximately a third of the global population by 2030 and the largest age cohort in the world [26]. In the Asia–Pacific region, it is poised to constitute a quarter of the population by 2025 [27]. Gen Z was estimated to represent 18.2% of Australia's population according to the 2021 Census [16].

Despite the existing evidence that Gen Z cares about climate change [25] and the various actions this age cohort is already taking [28, 29], it is unclear whether all members of this generation in Australia see global warming as a major issue the world is facing. To better comprehend the dynamics driving Australia's university Gen Z's concerns and engagement with social change behaviours in response to global warming, the study also delves into the unique technological context that shapes these young people's views and actions by exploring their forms of communication. Analysing these factors provides valuable insights into what propels Gen Z, offering a nuanced

understanding of this generation's concerns which influence their perceptions, motivations, attitudes and aspirations. This can consequently influence Australia's and the global trajectory related to climate change.

Methodology and sample description

An online quantitative survey was conducted in Australia between September 2021 and April 2022 using Qualtrics (<https://www.qualtrics.com/>). An ethics approval for the survey was obtained from Curtin University Human Research Ethics Committee. The quantitative methodology was selected due to its capacity to yield representative insights into the social landscape of Gen Z as it relates to concerns about climate change. This method allows for data to be generated that can be effectively conveyed through statistical analysis and numerical representations [30]. Such objective data can foster informed discussions, as it provides a solid foundation for the description of a large cohort [31]. A quantitative survey method allows to analyse the prevalence of opinions, concepts, characteristics and their measurable, numerical relationships. Not only can profound knowledge about Gen Z be gained, but it also encourages meaningful conversations and social dynamics debates.

A description of the instrument used for the survey is presented in Table 1. It contains eleven questions, one of which is open-ended while the other ten have pre-determined options. Three questions were used for screening the participants, namely for being part of Gen Z (Question 1), residents of Australia (Question 2) and students (Question 6).

The following study protocol was followed. All study subjects were recruited through university personnel who advertised the survey electronically across Australian universities inviting students to take part in a study on Gen Z. Information about the survey and the Qualtrics web link were given. Any willing participants were asked to anonymously provide their perspectives and opinions through both forced-choice and open-ended questions. The participants were self-selected and the survey was completed anonymously with no identifying data attached to it. There were no direct benefits to the participants accept being given the opportunity to be part of a study that would provide insights about characteristics, outlooks and behavioural preferences of Gen Z related to climate change. The data was analysed using basic descriptive statistics, such as means and percentages.

Personal and institutional networks across Australian universities were used to communicate the information about the Gen Z survey. Five academics across different Australian universities announced the survey

through online teaching platforms, such as Blackboard and Moodle, as well as with targeted emails to student populations. A private database of people who have expressed their desire to participate in surveys related to food was also used to invite participants. Those who had completed the survey were encouraged to share the information and link with their fellow-colleagues generating a snowballing effect. Given these different ways of announcing the survey, it is difficult to estimate the response rate. Although a response rate can indicate the statistical vigour of a survey and avoid nonresponse bias, in reality this is not essential when attempts have been made to spread the word as widely as possible. In this case we used emails, online announcements and word of mouth. This was a non-probability convenience sampling where the aim was to reach as wider an audience as possible. With the use of mixed ways of targeting participants, including through online platforms, it is difficult to compute or estimate the response rate [32]. However, "[s]urvey recruitment is considered successful if enough members of a targeted population fully complete a survey to enable meaningful data analysis to occur" [33], 864). In this case, a statistically representative sample without a gender bias was recruited.

A total sample of 446 ($n=446$) representatives of Gen Z participated in the survey, after providing their consent to take part in the process. The participants were university students from across different states and territories in Australia: New South Wales, Queensland, Victoria, Western Australia and the Australian Capital Territory. Table 2 summarises the demographic characteristics of the 446 representatives of Gen Z who took part in this study. The gender in the sample was wellbalanced with females representing 51% ($n=229$), males accounting for 47% ($n=209$) of the total participants and 2% ($n=8$) of the participants did not disclosing their gender. Although representative for the 4.6 million Australian Gen Z population (with a confidence interval of 4.64 and 95% confidence level), the participating sample is similarly representative of Australia's university student population. As it covered only university students, the sample is better educated than Australia's total Gen Z population. In total, 88% ($n=394$) of the participants were full-time students, 9% ($n=39$) were studying part-time and 3% ($n=13$) did not provide a response for this specific question.

Regarding household income, most of the sample, 69% ($n=309$), responded to belong to the 'Higher than AU\$122,000' yearly bracket, 26% ($n=117$) identified themselves in the 'Between AU\$40,500 and AU\$122,000' yearly bracket, 4% ($n=19$) responded to belong to the 'Lower than AU\$40,500' yearly bracket and only one participant did not provide a response. These results suggest that the majority

Table 1 Survey instrument used for the 2021–2022 Australian Generation Z survey

#	Question:	Optional answers
1	Please select the range that includes the year you were born.	<ul style="list-style-type: none"> o 1945 and earlier o 1946–1964 o 1965–1980 o 1981–1994 o 1995–2001 o 2002–2010
2	A resident of which country are you?	<ul style="list-style-type: none"> o Australia o Other
3	In which state/territory do you currently reside?	<ul style="list-style-type: none"> o Australian Capital Territory o New South Wales o Northern Territory o Queensland o Tasmania o South Australia o Victoria o Western Australia o Other
4	Are you currently enrolled in a college or university?	<ul style="list-style-type: none"> o Yes, I am a full-time student o Yes, I am a part-time student o No
5	Please indicate your gender identity	<ul style="list-style-type: none"> o Man o Woman o Intersex o Other o Prefer not to say
6	Which of the following best describes your household income during high school?	<ul style="list-style-type: none"> o Lower than \$40,500 (in today's rates) o Between \$40,500 and \$122,000 (in today's rates) o Higher than \$122,000 (in today's rates)
7	To what extent are you concerned about each of the following issues? (Not concerned; Slightly concerned; Somewhat concerned; Concerned; Very concerned)	<ul style="list-style-type: none"> o Climate change o Population growth o Sustainable food systems o Biodiversity loss o Plastic pollution o Waste o Soil fertility o Other
8	Which of these is your biggest concern and why? (open-ended)	
9	In the last year, how frequently have you engaged in the following social change behaviours? (Never; Rarely, e.g. 1–2x during the year; Sometimes, e.g. monthly; Often, e.g. weekly; Regularly, e.g. daily)	<ul style="list-style-type: none"> o Stayed informed about social issues I am concerned about o Participated in community service related to a social issue I am concerned about o Shared information with others about a social issue I am concerned about o Changed a personal behaviour or my lifestyle to address a social issue I am concerned about o Participated in an advocacy event (protest, marches etc.) on a social issue I am concerned about o Donated money to organisations that work to address a social issue I am concerned about o Refrained from buying goods or services from companies that don't support social issues or oppose social issues I am concerned about o Participated in a social media campaign around a social issue I am concerned about o Supported a political campaign (fundraising, lobbying, canvassing for a candidate) o Raised money for a social issue I am concerned about o Signed a petition to support a social issue I am concerned about

Table 1 (continued)

#	Question:	Optional answers
10	To what extent do you like to communicate with others using the following communication methods? (Do not like to use this method; Somewhat like to use this method; Like to use this method)	<input type="radio"/> In-person conversation <input type="radio"/> Video chat <input type="radio"/> Telephone call <input type="radio"/> Email messaging <input type="radio"/> Text messaging (iMessage, WeChat, GroupMe, WhatsApp) <input type="radio"/> Direct messaging through an app (Instagram messaging, Snapchat, Chats, Facebook messaging, IM, Tweets)
11	Which of the following platforms do you use the most frequently?	<input type="radio"/> Facebook <input type="radio"/> Twitter <input type="radio"/> Instagram <input type="radio"/> Snapchat <input type="radio"/> WeChat <input type="radio"/> WhatsApp <input type="radio"/> Viber <input type="radio"/> TikTok <input type="radio"/> YouTube <input type="radio"/> LinkedIn <input type="radio"/> Other

of the participants are most likely from professional families and most still living with their families. This survey is significant since this is the first statistically representative study of a sample drawn from the currently 672,177 Gen Z students enrolled in Australian universities about their concerns and behaviour related to the climate crisis and addressing climate change.

Results and Discussion

In order to understand better the Australian Gen Z's position and action on climate change, it was necessary to put things into perspective. This was done by asking students to indicate their level of concern about a range of environmental issues in a forced-choice question and then they were given an open-ended question to state their biggest concerns. In addition, the Gen Z participants were given a list of social change behaviours asking

them to indicate how often they engage in such activities. Although this list was not specific to climate change, it covered activities that are applicable to climate action and advocating for climate action. The results are presented and discussed below.

How concerned is Australia's Gen Z about climate change?

The participants were given a range of environmental issues about which they had to express their level of concern. They included 'biodiversity loss', 'climate change', 'plastic pollution', 'population growth', 'soil fertility', 'sustainable food systems' and 'waste'. Overall, the shares of young people who did not express any level of concern were very low indicating that Gen Z is aware of the challenges they face.

Figure 1 provides a visual representation in percentages of the answers. The findings underscore that among

Table 2 Demographic characteristics of the Australian Generation Z sample for the 2021–2022 study

Demographic parameters	Category	Total number (n = 446)	%
Gender	Female	229	51%
	Male	209	47%
	No response	8	2%
Student type	Full-Time	394	88%
	Part-Time	39	9%
	No response	13	3%
Household income	Higher than AU\$122,000 (in today's rates)	309	69%
	Between AU\$40,500 and AU\$122,000 (in today's rates)	117	26%
	Lower than AU\$40,500 (in today's rates)	19	4%
	No response	1	0%

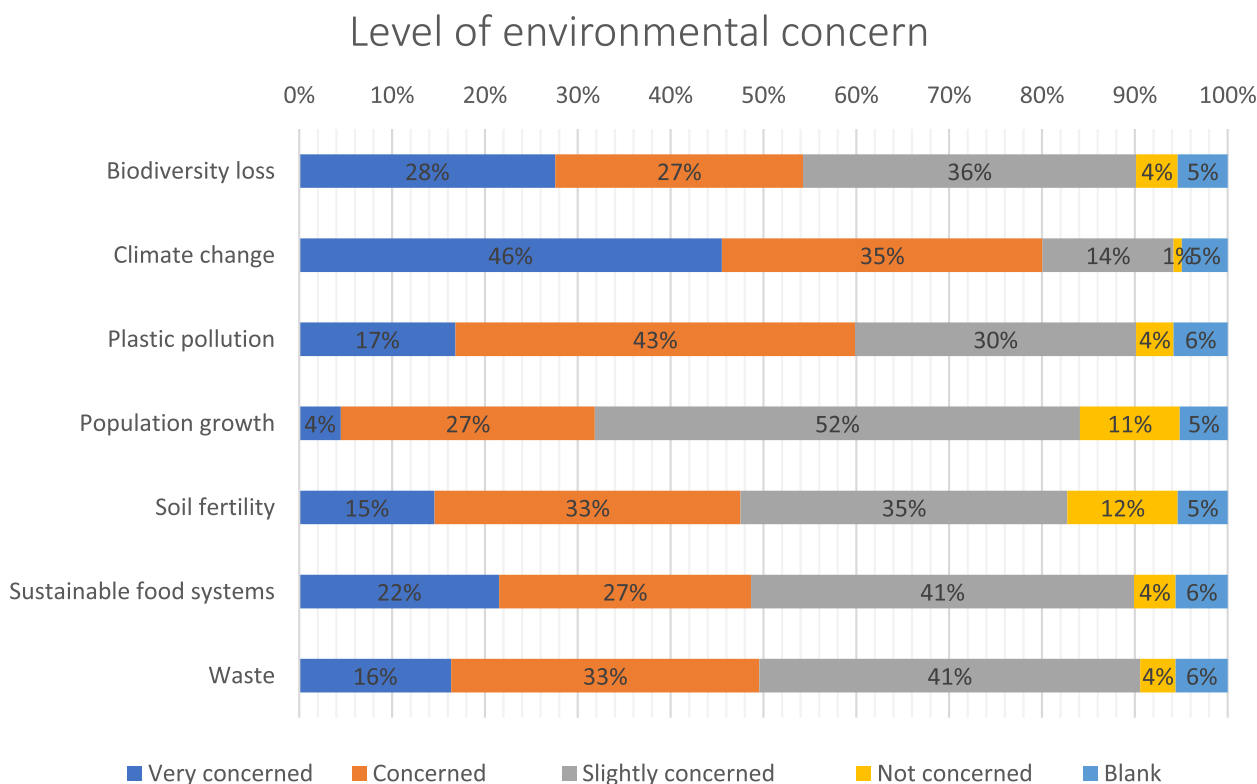


Fig. 1 Levels of environmental concern of the Australian Generation Z sample for the 2021–2022 study (%)

university Gen Z in Australia, 'climate change' emerged as the foremost concern, with 46% ($n = 203$) of the participants expressing they are 'very concerned', marking the highest percentage within this category. When combined with those who are 'concerned', this figure rises to 80% ($n = 357$), making it the most significant environmental concern. It is notably higher than other concerns, such as 'plastic pollution' at 60% ($n = 267$) and 'biodiversity loss' at 54% ($n = 242$), when both 'very concerned' and 'concerned' responses are combined. Only 1% of the participants stated that they were not concerned about climate change. At the other end of the spectrum, population growth did not attract very high levels of concern, namely 31% combined for 'very concerned' and 'concerned' and 11% not concerned at all.

These results mirror the findings from various other studies, reinforcing the consensus that climate change stands out as the top apprehension among members of Gen Z [29, 34–39]. The study by Hickman et al. [14] reinforces these sentiments with 83% of the young participants being of the opinion that people have failed to take care of the planet. The Australian participant sample is also in line with international levels of apprehension, such as in the USA where 83% of adult Gen Z has some level of concern about climate change and the

environment [40]. Climate change also appears as the biggest problem Gen Z is facing in Europe [41].

The findings of the study are not surprising given that Gen Z are the population cohort tasked with responding to climate change and living with the consequences from other serious environmental degradation, such as plastic pollution where 60% of the surveyed Gen Z are 'very concerned' or 'concerned'. Plastic pollution affects the ability of the planet's ecosystems to absorb carbon and mitigate climate change [42]. Although sustainable food systems and reduced soil fertility attract lower levels of concern, 49% and 48% respectively for the two high-concern categories, these issues are likely to be further exacerbated by climate change.

As in other studies [25], the survey results show that Australia's Gen Z is also concerned about biodiversity loss. Although there is a direct link between biodiversity loss and climate change, this issue is more complex with another major contributor being clearing of land from native vegetation for conversion into pasture land for grazing and fodder growing. This is particularly pronounced in Australia where land conversion for livestock pastures and other agricultural uses continues [43]. People's food choices significantly impact on both, climate change and biodiversity loss [44]. Because of its

complexity, this relationship was not explored further in the current survey but it requires future attention.

All environmental concerns of Gen Z, including Australia's university students, stem from the behaviours of previous generations, particularly the Baby Boomers (born between 1946 and 1964), who were pre-occupied with economic development and had lower levels of environmental awareness. The predominant lifestyle and production methods were oriented towards consumption and overconsumption of natural resources without acknowledging the limitations of the planet. Sustainability principles were not followed and nature's ability to rejuvenate and provide for human existence was taken for granted. This leaves Gen Z a different, less secure and environmentally deteriorating world.

Is Australian Gen Z succumbing to climate anxiety?

Additionally, the study explored Australian Gen Z participants' biggest concerns through an open-ended question, allowing individuals the flexibility to express a wide range of worries experienced by them. Overwhelmingly, 'climate change' emerged as the most significant concern, with 19% ($n=85$) of participants identifying it as the most pressing issue in society. According to Clayton et al. ([13], 68), climate anxiety is "a chronic fear of environmental doom". Since climate change is already happening, with dangers expected to grow in the coming decades [45], it can be expected that Gen Z is already experiencing feelings of climate anxiety.

As reported by the IPCC [3], increases in the frequency and intensity of climate and weather events, such as hot extremes, heavy precipitation, droughts and wild fires, are already having widespread and damaging impacts on ecosystems, people and infrastructure around the world. Furthermore, it is predicted that reaching and surpassing 1.5 °C degrees of global warming above pre-industrial levels will have fatal consequences on society, such as biodiversity loss, water scarcity, increases in food insecurity and poor health and premature deaths [3]. Therefore, as Reyes et al. [37] explain, increasing knowledge about climate change and its potential devastating consequences on planetary health, can trigger feelings of anxiety, depression and stress in individuals. Similarly previous research shows members of Gen Z agree with the scientific community in that global warming is caused by human activities and has life-threatening impacts – facts influencing these young people to develop symptoms of anxiety, stress and depression [35, 37, 38, 46].

In Germany, studies conducted among primary school children have revealed significant concerns about terrorism, war, poverty, and, notably, escalating environmental pollution [29]. A survey in 2021 revealed that 62% of German youth were particularly worried about environmental

pollution [47]. In 2019 and prior to the COVID-19 pandemic, this figure was 71%, with 65% expressing worry about climate change, as reported by Hurrelmann and Albrecht [29]. Similarly, the American Psychological Association [48] found that 68% of Gen Z experience stress concerning their future, driven in part by the looming threats of climate change.

Confronted with the realities of climate science, a growing number of Gen Z members are voicing their concerns about the devastating impacts of climate change, identifying it as the most pressing global issue today [29, 34–39, 49]. For instance, a global survey conducted by Amnesty International found that 41% of young people regarded climate change as the top challenge facing the world [34]. Additionally, a 2017 survey by the World Economic Forum revealed that nearly half of young adults globally considered climate change the most serious issue of our time [38]. There is also a significant generational gap with younger people being more prone to fears about a climate change future. A study by the Pew Research Centre indicated that 52% of young Americans, aged 18 to 29, viewed climate change as an extremely urgent issue, compared to only 38% of adults aged 50 and older who shared the same concern about the climate crisis [50]. Specifically among Gen Z members who engage with social media platforms, the level of anxiety about the future is very high at 69%, predominantly as an emotional reaction to climate change [51].

Considering the impact of gender, it is noteworthy to mention that it often serves as a predictor of attitudes towards climate change, with more women than men displaying heightened concern about this issue [52, 53]. To investigate this further, the study of Australian student Gen Z analysed responses based on gender and found that women and men within the sample group demonstrated nearly equal levels of concern. Specifically, 48% ($n=41$) of women and 46% ($n=39$) of men chose climate change as their most significant concern.

Interestingly, these results deviate from some previous research findings in which women are more concerned about climate change. One possible explanation for this discrepancy could be the educational background of the sample group, namely university students. Access to education and knowledge might lead to more positive attitudes towards climate change. Indeed, students pursuing environmental degrees exhibit higher awareness and concern regarding environmental issues [37]. Therefore, the educational context of the sample group might have influenced their concerns about climate change, leading to a more balanced gender distribution in this particular study.

On the other hand, young people often feel ignored or dismissed when they talk about climate change [14].

This impacts the way they see their place within society, with climate anxiety being reflected in their overall mental health. Climate anxiety is often triggered by the failure of older generations to act on the available scientific evidence with younger people feeling betrayed, powerless, vulnerable and distressed [14]. Governments and the corporate world are slow to act leading to feelings of disillusionment, frustration and rising stress for Gen Z [54].

Gen Z faces an unparalleled behavioural health crisis, marked by a grim outlook and a high prevalence of mental health issues. In the US, Gen Z surveyed by McKinsey [55], has expressed the least positive outlook and presented with the highest rates of mental illness among all generations. Additionally, European respondents have reported struggles with self-stigma related to mental health. This pervasive pessimism is fuelled by a load of global challenges, including growing unrest, wars, disruptions, financial crises and educational interruptions, particularly exacerbated by the COVID-19 pandemic and the geopolitical situation.

The burden of "climate anxiety" further adds to Gen Z's worries. Many young people find themselves constantly preoccupied with the fate of the planet, reflecting their deep concerns about environmental issues [56]. Moreover, economic prospects are dwindling, with diminished opportunities and a lack of confidence in traditional safety nets. Saving for retirement becomes increasingly challenging, especially amid shrinking pensions and a growing older population.

Notably, a substantial portion of Gen Z (58%), as per the McKinsey survey, reports unmet basic social needs, highlighting the profound challenges they face in securing basic essential necessities [55]. This distressing reality emphasises the urgency of addressing the mental health and well-being of Gen Z, demanding comprehensive support systems and proactive measures to alleviate their anxieties and uncertainties in the face of these overwhelming challenges before they severely impact their education and job opportunities.

Is Australian Gen Z engaging in climate activism?

The survey explored the participants' engagement in social change behaviours to advocate for their concerns, including climate change. A significant portion of the sample group were not actively involved in mainstream social change activities related to the issues they are concerned about. Figure 2 provides a visual representation of the frequency of participants' engagement in social change behaviours over the previous year.

With the eleven options given to the participants (see Fig. 2), an overwhelming 65% ($n=288$) of them reported 'never' or 'rarely (1–2 times during the year)' engaging

in social change behaviours to address their concerns, including climate change. Particularly striking was the low engagement in supporting political campaigns, with 56% ($n=251$) of individuals stating they 'never' participated in such activities. Although there are differences in the opportunities for engagement in a particular social change behaviour, e.g. staying informed and sharing information about an issue of social concern can be done with a higher frequency than signing a petition, the shares of those who reported that they were engaged with such activities often or regularly were very low across all categories, except staying informed about an issue of concern. This is consistent with research by Cambridge University which shows that young people are losing faith in democracy [57]. In Australia, post-millennials are similarly disillusioned with democracy and uninterested in elections [58]. Although School Strike 2 Climate and Fridays For Future activities show active engagement, this activism does not seem to spread to Australia's university Gen Z cohort.

Staying informed about social issues emerged as the most frequent activity, with 39% ($n=174$) of the participants doing so on a monthly basis and another 30% ($n=136$) either weekly or daily. These results imply that individuals within the sample group tend to be more passive in their climate change advocacy, opting for informational awareness rather than active engagement.

Considering that the majority of these individuals are full-time students (88%, $n=394$), it is plausible that time constraints due to academic commitments restrict the frequency of their participation. Most of the sample participants still live with their parents which further impacts on the types of behaviours that they can adopt. Given the car dependency of most Australian cities, geographical location and proximity to certain events may also be affecting engagement. However, it is crucial to note that some previous research highlighted low levels of climate activism within Gen Z, including college-aged students [49, 53]. Therefore, it is recommended that further research be conducted to identify potential barriers preventing Gen Z students from becoming more actively engaged in the social issues they deeply care about, including climate change advocacy.

On the surface, these results may look different from previous global research which shows that 70% of Gen Z is involved in a social or political cause [59]. However, the current survey looked at traditional levels of social engagement while the nature of young people's activism in Australia has been changing with many being disenchanted with the unresponsiveness of the existing political structures [60]. Gen Z is in fact changing the face of activism by using technology to voice its individualised

In the last year, how frequently have you engaged in the following social change behaviors?

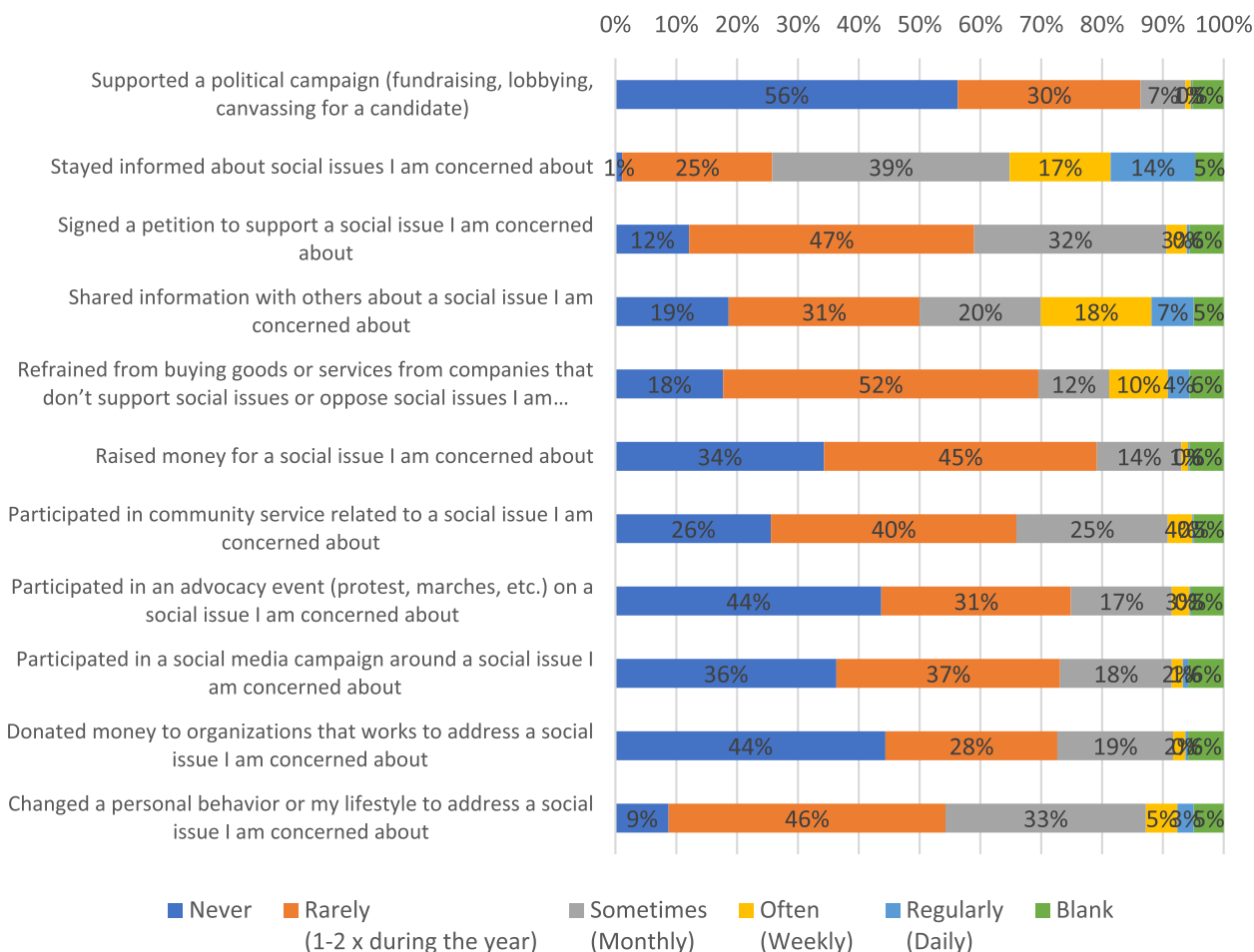


Fig. 2 Frequency of participant engagement in social change behaviours in the last year for the Australian Generation Z sample used in the 2021–2022 study (%)

concerns [57]. It is also opting for less traditionally-political behaviour positioning itself with improved professional knowledge and skills.

As stated by Miller et al. ([61], 233), climate activism stems from “collective trauma and injustice, carrying on legacies of previous generations of activists who radically reimagine our society”. This driving force underpins the global climate protests initiated by Gen Z in recent years. The phenomenon of global school strikes, which began in 2018 to protest the lack of political action on climate change, has notably drawn the world’s attention to the climate crisis [36, 49]. This movement distinguishes itself from its predecessors. Hurrelmann and Albrecht [29] point out that the primary objective of this movement is not personal gains of freedoms, but ensuring the

humanity’s survival by demanding stronger regulations in corporations and their activities – a mission geared toward the well-being of the entire society. Central to this movement is the iconic figure of Greta Thunberg who epitomised the climate activism and rebellion of Gen Z, and she has become a global phenomenon inspiring millions of school kids to strike with her. Thunberg’s journey began when, at just 15 years old, she protested alone by sitting in front of the Swedish parliament to demand stronger action on climate change, missing school for three weeks [62]. This solitary act sparked the creation of the Fridays for Future (FFF) movement, mobilising millions of young people worldwide to strike for climate.

In March 2019, approximately 1.4 million young activists from 2,233 cities around the globe walked out of

schools to protest [28]. By September 2020, an estimated 6 million people joined a week of climate protests worldwide [63], uniting thousands of young people across the globe to fight for climate change [29]. Since its creation, FFF has mobilised 116 million strikers from 215 countries and 8,600 cities around the world [64]. Greta Thunberg's unprecedented dedication led her to be named Time Magazine's person of the year in 2019 [65]. However, not all climate activism has gained worldwide attention. There are numerous instances of youth activism, such as the case of Utah in the United States, where students fought hard to introduce a law not only to reduce GHG emissions in the state, but also to support technologies and services that enhance the economy through more efficient and cost-effective energy usage [45]. Farber ([45], 300) emphasizes the significance of this story, particularly because Utah is a conservative state, showcasing that youthful activism is not confined to areas with progressive politics. The success of these climate activism endeavours lies in the idealism of youth, which, as stated by Edwards [66], calls out when adults fail to live up to their own standards.

Despite the achievements in raising awareness about climate change, young activists remain a minority within Gen Z. Inequalities such as disparities in school enrolment, internet and computer access, and proximity to strike gatherings limit the participation of certain groups ([49] 269). Climate anxiety may already be acting as a factor that causes paralysis and inaction among young Australians. A study by Hickman et al. [14] indicates that half of young people (50% in Australia and 56% globally) think that humanity is doomed. The majority of those who are active about climate injustice and other societal issues are increasingly engaging through the social media [51, 67].

How is Australia's Gen Z communicating?

Among the digital-native Gen Z, social media not only serve as a powerful communication tool but also play a vital role in climate activism. Consequently, this study sought to unravel the preferred communication methods of the sample group, with a particular focus on social media, and the primary purposes for which these platforms were utilised. The survey assessed various communication methods, including direct messaging through an app, email messaging, in-person conversation, telephone calls, text messaging and video chat. Table 3 displays the participants' preferences for these methods, while Fig. 3 outlines the preferred social platforms according to the frequency of use.

Surprisingly, 'in-person conversation' emerged as the most favoured communication way, with 81% ($n=361$) of the participants expressing their preference for this method. Even more striking, 87% ($n=390$) revealed

that they predominantly utilised in-person conversations in their communication practices. This preference seems contradictory to the wide-spread perceptions of Gen Z being digital natives with social media as their primary means of communication and knowledge acquisition [68]. One possible explanation could be the impact of the COVID-19 pandemic, with lockdowns in various Australian cities potentially influencing the responses. Although this aspect was not within the study's scope, it poses an intriguing area for future research.

Following closely, 'direct messaging through an app' was the second most popular communication tool, with 63% ($n=282$) of participants expressing their liking for this method. Furthermore, 72% ($n=282$) stated that they frequently communicated using this approach. These results align more closely with the literature review and particularly the study by Mezgaile et al. [68], which highlights social media platforms and direct messaging apps as preferred channels of communication for Gen Z. In contrast, 'email messaging' emerged as the least favoured communication method, garnering approval from only 16% ($n=72$) of participants. Moreover, a mere 15% ($n=65$) indicated using email messaging often. This finding is consistent with previous research, which indicated that email is not a preferred means of communication or knowledge gathering among Gen Z [68].

While in-person conversations seemingly dominate Gen Z's communication preferences and practices, the prevalence of social media and direct messaging apps for certain purposes, such as climate activism, cannot be discounted. The interplay between these preferences, the COVID-19 pandemic and the evolving digital landscape offer a rich avenue for further investigation, shaping a comprehensive understanding of Gen Z's communication behaviours and their role in climate activism.

When it comes to social media platforms, the sample group of Australian university students showed a clear preference for Snapchat and Instagram, with 42% ($n=188$) and 30% ($n=134$) of the participants selecting these platforms as their most preferred ones. This shows Australia's Gen Z acting similarly to young people in other parts of the world who also prefer to use Instagram and Snapchat [68]. However, they are less keen to utilise Facebook, YouTube and TikTok as their primary platforms. In terms of their usage rationale, participants cited using Snapchat and Instagram for sharing personal information, expertise, content or opinions, as well as for keeping up with others' lives. Concerning Instagram specifically, participants mentioned employing this platform for influencing or persuading others. These platforms play a pivotal role in

Table 3 Extent to which the Australian Generation Z sample for the 2021–2022 study likes to communicate using the listed methods (%)

Communication method	Like to use this method	Somewhat like to use this method	Do not like to use this method	Blank	Total
In-person conversation	81%	15%	0%	4%	100%
Direct messaging through an app	63%	26%	6%	5%	100%
Text messaging	54%	39%	2%	5%	100%
Telephone call	40%	31%	24%	5%	100%
Video chat	35%	40%	20%	4%	100%
Email messaging	16%	36%	43%	5%	100%

More frequently used social platforms

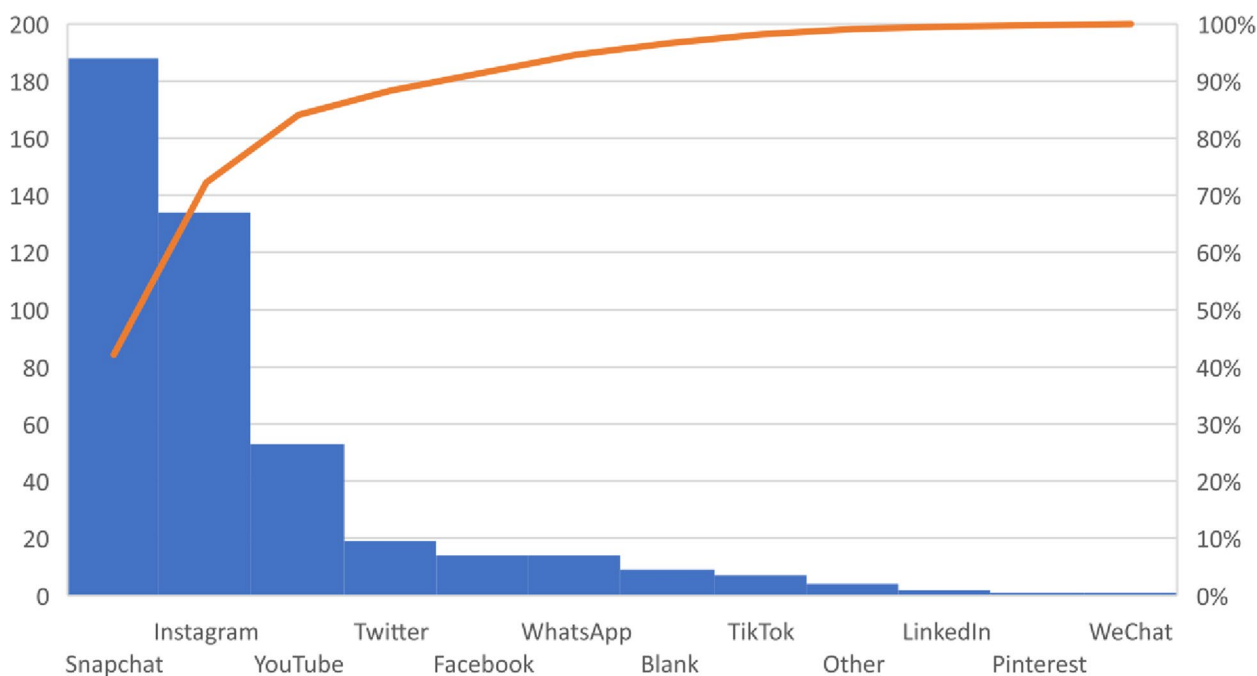


Fig. 3 More frequently used social platforms by the Australian Generation Z sample for the 2021–2022 study (%)

Gen Z’s communication landscape by allowing multifaceted use, encompassing personal interactions, knowledge exchange and influencing others, shaping a complex digital ecosystem that mirrors the diverse interests and pursuits of this generation.

Indeed, Gen Z’s proficiency in modern technology and expert use of social media platforms have become powerful tools driving climate change and political activism. Young individuals are harnessing these platforms to increase awareness about environmental issues and advocate for causes they deeply care about. For instance, prominent climate activist Greta Thunberg, with millions of followers on Twitter and Instagram, has successfully mobilised masses worldwide for climate protests, primarily coordinated through social

media platforms [64]. Thunberg’s advocacy has gained momentum through endorsements from influential figures such as the former US President Barack Obama and popular comedian Ellen DeGeneres, significantly expanding the reach of her message [69].

Furthermore, Gen Z has exhibited remarkable creativity in leveraging social media for political activism. In a notable example from 2020, young activists utilised TikTok to coordinate a protest against the former US President Donald Trump. They strategically manipulated the RSVP system, resulting in numerous empty seats at a rally in Tulsa [36]. These instances emphasise the significant impact technology and social media can have in mobilising youth movements and shaping political discourse.

However, it is essential to acknowledge that these digital tools are not without risks for young activists. The same platforms that empower them with global reach and influence are also vulnerable to threats. Misinformation, cyberbullying and privacy breaches are persistent challenges that Gen Z activists face online. While technology and social media offer unprecedented opportunities, it is crucial to address these risks, ensuring a safe and supportive online environment for young individuals engaged in climate and political activism. Special efforts in education and regulation are essential to safeguard the digital spaces where Gen Z's activism thrives.

Limitations of the study

Although statistically representative of Australia's university student population, the study has a number of limitations. First, the respondents were self-selecting to participate in the survey rather than being randomly approached. Second, the list of environmental issues was forced choices rather than free-choice. This could potentially generate higher levels of concern compared to when it is left to the students' own knowledge to generate responses. Third, there was no care taken to obtain a sample that is representative of the socio-economic backgrounds of the students (e.g. professional vs low-income families) or their geographic location (e.g. big cities vs remote communities). Another limitation is that university students are a very specific part of Gen Z and any generalisations from this study should be made with care.

This study offers insights about Australia's Gen Z and some of the findings may be specific about this population. Also, comparisons with other countries are being made based on previous research, but these studies in most cases refer to general Gen Z and not necessarily university students.

There are two main aspects about generalising from the findings of this study. The first relates to whether the insights from this research are applicable to the total Australian Gen Z. Although there are generational similarities, the participants in the current study are better educated than their average counterparts which indicates that any generalisations need to be made with care. The second aspect is how these findings relate to other Gen Z university populations around the world. Again, any generalisation needs to be carried out with care, particularly given the small size of Australia's population.

Comparisons with similar research projects may help in arguing pro or against the case how indicative the trends in Australia are for the global Gen Z. For example, in 2022 a global survey was conducted of university students, which analysed the societal concerns of 13 thousand Gen Z participants. The results show that climate change is one of Gen Z's top societal concerns with 60%

of the young people being very concerned or concerned, compared to 81% in the current study, and 9% being not concerned, compared to 1% in the current study [70]. This indicates that the study sample of the Australian university population is more aware and worried about the impacts of global warming and extreme weather events that are felt particularly strongly on this continent, including wildfires, droughts and floods. In other words, global Gen Z is becoming anxious about climate change but the degree of concern is higher in places where its impacts are already being demonstrated. This results in climate anxiety that is not necessarily as pronounced in other parts of the world.

Recommendations and conclusion

The findings of this study highlight that although Australian university students are very passionate about climate change, climate anxiety may be a defining characteristic of Gen Z. While this anxiety can serve as a powerful motivator driving individuals toward climate activism, it also has some really concerning implications for the health and well-being of young people. Consequently, climate anxiety manifests as both a potential weakness and strength for this generation, depending on the paths individuals follow.

It is crucial to initiate further in-depth discussions and research on the impact of climate anxiety on the emotional well-being of Gen Z. Comprehensive studies are needed to delve into this complex issue and understand its nuances fully. Moreover, there is a pressing need to develop effective strategies aimed at assisting individuals, especially the youth, in channelling their climate-related fears in a positive direction, including through their employment and career choices. In addition to individual strategies, it is imperative for governments worldwide and in Australia to acknowledge the seriousness of climate anxiety and allocate substantial resources toward mental health support. These resources should be integrated into national campaigns designed to alleviate anxiety in young children, which is often triggered by fears of climate change and natural disasters. This becomes particularly applicable in the face of accelerated global warming, leading to more frequent and severe natural disasters.

Furthermore, governments should take proactive measures to incorporate climate science into school curriculums. Educating children not only about the causes and consequences of climate change but also about existing solutions at various societal levels, including the individual level, can empower them to take meaningful action in all possible ways available in a democratic society. This can significantly mitigate feelings of depression, stress and the paralysing effects of climate anxiety.

Building on the research findings, it is evident that only a minority of Gen Z actively participates in climate demonstrations, highlighting the need for further investigations into online and social media climate activism and the motivations influencing young people's engagement. School education is the foundation on which university students build their knowledge, perceptions and develop further their attitudes towards climate change. Including climate change topics in earlier education can significantly impact young minds, fostering awareness and a sense of responsibility toward environmental issues [71] and equip them with the knowledge and tools necessary to tackle these challenges and advocate for sustainable practices. Australia's new school curriculum released in 2022 has improved the coverage of climate change issues across a diverse range of topics, including geography, history, science, mathematics, technologies, citizenship and the arts [72], however, the study sample would have not been exposed to it. Many different social identities may influence individuals' concerns, perceptions and behaviours towards the urgency and enormity of the climate change challenge. To address this gap, integrating climate change education (e.g., effects on complex global issues, poverty and inequality, biodiversity loss and deforestation) into school and university curriculums globally at all levels emerges as a compelling solution.

Additionally, integrating the United Nations Sustainable Development Goals (SDGs) into the educational framework is essential. These goals serve as a global roadmap, outlining the collective efforts required to ensure a sustainable planet by 2030. By engaging students in the principles and objectives of the SDGs, educational institutions can instil a deep sense of purpose and global citizenship influencing career paths and employment choices. Understanding these goals equips students with a holistic perspective, encouraging them to actively engage with environmental, political and social issues. Empowering students to voice their concerns, demand change and participate in peaceful protests, when necessary, can create a generation of active and socially responsible individuals in addition to their engagement online and with their peers through direct conversations and messaging apps.

The use of communication ways by Gen Z should also be taken into consideration whilst devising any further policies and action in relation to climate change. In-person communication and messaging through an app, such as Snapchat or Instagram where young people can instantly exchange multimedia content without retaining it in the long run, are preferred by Gen Z who seem to prefer immediate reaction to any concerns raised.

Moreover, it is imperative to conduct additional research to explore a crucial question regarding whether the concerns and positive attitudes toward climate action observed in Gen Z persist into their adulthood. Given that many individuals in Gen Z are still in their formative years and have yet to undergo significant life experiences that could shape their perspectives, understanding the longevity of their proactive viewpoint and attitude on climate action is essential. As this generation matures and faces various life events, their beliefs, values and priorities may undergo transformation. Therefore, in-depth studies tracking the evolution of concerns, perceptions and attitudes toward climate action as individuals transition into adulthood can provide invaluable insights into this direction.

Generation Z is not only advocating for climate change, but also for a system change. Young individuals are campaigning for political and social change; they are fighting for social justice and equality, and for governments to prioritize human well-being over economic growth. Nonetheless, climate activists among Gen Z are still a minority, especially among university-age students, and therefore, further studies are required to identify barriers preventing young individuals to engage in traditional climate and political activism.

Furthermore, it is important to recognise that members of Gen Z, despite their passion and commitment, currently lack significant influence in decision-making positions. Their efforts to combat climate change could face substantial challenges if they cannot effectively persuade older generations to adopt more robust climate policies and regulations. Convincing sceptical adults to take urgent action on climate change is crucial for the success of their mission. However, an important question arises: Will there be enough time to make a meaningful impact? Given the urgency of the situation, equipping Gen Z with good negotiation and persuasion skills is essential to empower them to engage in constructive dialogues with older generations, encouraging understanding and collaboration, leading to effectively advocate for the implementation of impactful climate policies.

While the challenges of the polycrisis are scary, it is not too late for Gen Z to make a difference fighting for a sustainable future. With climate change being the top environmental concern for Australia's university Gen Z, it is easy for these young people to succumb to climate anxiety. Perhaps the solution is simpler than it seems and it is that young people should connect more to other generations through traditional climate activism. As David Attenborough once asked [73]: "The world belongs to young people... the younger generation is very, very passionate and concerned about the next 60, 70 years that's facing them and how else are they to do it?"

Abbreviations

COVID-19	Coronavirus disease of 2019
FFF	Fridays for Future
Gen Z	Generation Z
GHG	Greenhouse gas emissions
IPCC	Intergovernmental Panel on Climate Change
RSVP	Répondez s'il vous plaît
SDGs	Sustainable Development Goals

Acknowledgements

The authors acknowledge all Australian participating universities and an international team collaboration led by Corey Seemiller and Meghan Grace.

Authors' contributions

All authors conceptualised, analysed the data, drafted and approved the final manuscript. DM and DB collected the data and RBS carried out the preliminary analysis and developed the statistical representation of the data.

Funding

No funding was received to conduct this study.

Availability of data and materials

Data is available on request.

Declarations

Ethics approval and consent to participate

Ethics approval for this research was received from Curtin University Human Research Ethics Committee.

Consent for publication

The authors consent to their research being published.

Competing interests

The authors declare no competing interests.

Received: 30 October 2023 Accepted: 23 January 2024

Published online: 05 March 2024

References

- Intergovernmental Panel on Climate Change (IPCC) (2021). Summary for Policymakers. In *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. IPCC, Cambridge University Press. <https://www.ipcc.ch/report/ar6/wg1/chapter/summary-for-policymakers/> (Accessed 21 Jan 2024).
- United Nations (UN) News (2023). 'Humanity has opened the gates to hell' warns Guterres as climate coalition demands action. <https://news.un.org/en/story/2023/09/1141082> (Accessed 21 Jan 2024).
- Intergovernmental Panel on Climate Change (IPCC). Summary for Policymakers. In *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. IPCC, Cambridge University Press. 2022. <https://www.ipcc.ch/report/ar6/wg2/>. Accessed 21 Jan 2024.
- World Economic Forum (2023). *The Global Risks Report 2023*. World Economic Forum. <https://www.weforum.org/publications/global-risks-report-2023/digest> (Accessed 21 Jan 2024).
- COP28. COP28 Declaration Status Reprot. 2023. <https://www.cop28.com>. Accessed 3 Feb 2024.
- Intergovernmental Panel on Climate Change (IPCC) (2023). Summary for Policy Makers. In *Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. IPCC, Geneva, Switzerland. <https://www.ipcc.ch/report/sixth-assessment-report-cycle/> (Accessed 21 Jan 2024).
- Joyella, M. (2022). On Fox, Donald Trump calls climate change a 'hoax': 'In the 1920's they were talking about global freezing'. *Forbes*. <https://www.forbes.com/sites/markjoyella/2022/03/21/on-fox-donald-trump-calls-climate-change-a-hoax-in-the-1920s-they-were-talking-about-global-freezing/?sh=64375db63787> (Accessed 21 Jan 2024).
- Morton, A. (2019) Australian government seen globally as climate 'denial-ist', UN summit observers say. *The Guardian*. <https://www.theguardian.com/australia-news/2019/sep/25/australian-government-seen-globally-as-climate-denialist-un-summit-observers-say> (Accessed 21 Jan 2024).
- United Nations (2020). What is the Paris Agreement? <https://unfccc.int/process-and-meetings/the-paris-agreement/what-is-the-paris-agreement> (Accessed 21 Jan 2024).
- Intergovernmental Panel on Climate Change (IPCC). Summary for Policymakers. In *Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. IPCC, Cambridge University Press. 2022. <https://www.ipcc.ch/report/ar6/wg2/chapter/summary-for-policymakers/>. Accessed 21 Jan 2024.
- Clayton S, Karazsia BT. Development and validation of a measure of climate change anxiety. *J Environ Psychol*. 2020;69:101434. <https://doi.org/10.1016/j.jenvp.2020.101434>.
- Bourban M. Eco-anxiety and the responses of ecological citizenship and mindfulness. In: Kassiola J, Luke TW, editors. *The Palgrave handbook of environmental politics and theory*. Switzerland, Cham: Palgrave Macmillan; 2023. https://doi.org/10.1007/978-3-031-14346-5_4.
- Clayton S, Manning CM, Krygsman K, Speiser M. Mental health and our changing climate: impacts, implications, and guidance. *American Psychological Association and ecoAmerica*. Washington, DC. 2017. <https://www.apa.org/news/press/releases/2017/03/mental-health-climate.pdf>. Accessed 21 Jan 2024.
- Hickman C, Marks C, Pihkala P, Clayton S, Lewandowski RE, Mayall EE, Wray B, Mellor C, van Susteren L. Climate anxiety in children and young people and their beliefs about government responses to climate change: a global survey. *Lancet*. 2021;5:e863–73. [https://doi.org/10.1016/S2542-5196\(21\)00278-3](https://doi.org/10.1016/S2542-5196(21)00278-3).
- YouthSense (2019). 96% of Australian Gen Zs Believe in Human-made Climate Change. <https://youthsense.com.au/employers/gen-z-believe-human-made-climate-change/> (Accessed 21 Jan 2024).
- Australian Bureau of Statistics (ABS) (2022). 2021 Census shows Millennials overtaking Boomers. Media Release. <https://www.abs.gov.au/media-centre/media-releases/2021-census-shows-millennials-overtaking-boomers> (Accessed 21 Jan 2024).
- Universities Australia (2022). Data snapshot. https://universitiesaustralia.edu.au/wp-content/uploads/2022/08/220523-Data-snapshot-2022_web.pdf (Accessed 21 Jan 2024).
- Lewis J. Top 7 qualities universities look for in student applicants. *Times Higher Education*. 2017. <https://www.timeshighereducation.com/student/advice/top-7-qualities-universities-look-student-applicants>. Accessed 21 Jan 2024.
- McCrindle (2023). Generation Z commence university: Choosing the right course. <https://mccrindle.com.au/article/topic/generation-z/generation-z-commence-university-choosing-the-right-course/> (Accessed 21 Jan 2024).
- Grondin S. *Psychology of perception*. Switzerland, Cham: Springer; 2016.
- Meta & Climate Change Communication. International public opinion on climate change 2022. 2022. <https://climatecommunication.yale.edu/wp-content/uploads/2023/07/international-public-opinion-on-climate-change-2022b.pdf>. Accessed 21 Jan 2024.
- Jhangiani R, Tarry H. *Principles of social psychology*. BCcampus OpenEd. 2022. <https://opentextbc.ca/socialpsychology/>. Accessed 21 Jan 2024.
- Cambridge Dictionary (2023). Polycrisis. <https://dictionary.cambridge.org/us/dictionary/english/polycrisis> (Accessed 21 Jan 2024).
- Seemiller C, Grace M. *Generation Z: A century in the making*. London: Routledge; 2018.
- Bogueva D, Marinova D. Australian Generation Z and the nexus between climate change and alternative proteins. *Animals*. 2022;12:2512. <https://doi.org/10.3390/ani12192512>.
- Bumbac R, Bobe M, Procopie R, Giuscă S, Enache C. How Zoomers' eating habits should be considered in shaping the food system for

- 2030—a case study on the young generation from Romania. *Sustainability*. 2020;12(18):7390. <https://doi.org/10.3390/su12187390>.
27. Kim A, McInerney P, Rüdiger ST, Yamakawa N. What makes Asia—Pacific's Generation Z different? McKinsey. 2020. <https://www.mckinsey.com/capabilities/growth-marketing-and-sales/our-insights/what-makes-asia-pacifics-generation-z-different>. Accessed 21 Jan 2024.
 28. Carrington D. School climate strikes: 1.4 million people took part, say campaigners. *The Guardian*. 2019. <https://www.theguardian.com/environment/2019/mar/19/school-climate-strikes-more-than-1-million-took-part-say-campaigners-greta-thunberg>. Accessed 21 Jan 2024.
 29. Hurrelmann K, Albrecht E. *Gen Z: Between climate crisis and coronavirus pandemic*. Abingdon: Routledge; 2021.
 30. Burell NA, Gross C. t-Test. In: Allen M, editor. *The SAGE encyclopedia of communication research methods*. Online: SAGE Publications; 2017. <https://doi.org/10.4135/9781483381411>.
 31. Jones TL, Baxter MA, Khanduja V. A quick guide to survey research. *Ann R Coll Surg Engl*. 2013;95(1):5–7. <https://doi.org/10.1308/003588413X13511609956372>.
 32. Frandsen M, Thow M, Ferguson SG. The effectiveness of social media (Facebook) compared with more traditional advertising methods for recruiting eligible participants to health research studies: a randomized, controlled clinical trial. *JMIR Res Protoc*. 2016;5(3):e161. <https://doi.org/10.2196/resprot.5747>.
 33. Barnes LAJ, Barclay L, McCaffery K, Rolfe MI, Aslani P. Using Facebook to recruit to a national online survey investigating complementary medicine product use in pregnancy and lactation: A case study of method. *Res Social Adm Pharm*. 2021;17(5):864–74. <https://doi.org/10.1016/j.sapharm.2020.07.011>.
 34. Barbiroglio E. Generation Z fears climate change more than anything else. *Forbes*. 2019. <https://www.forbes.com/sites/emanuelbarbiroglio/2019/12/09/generation-z-fears-climate-change-more-than-anything-else/?sh=7950ebd5501b>. Accessed 21 Jan 2024.
 35. Bogueva D, Marinova D. Autonomous Sensory Meridian Response (ASMR) for responding to climate change. *Sustainability*. 2020;12(17):6947. <https://doi.org/10.3390/su12176947>.
 36. Hess T. "Gen Z Will Save Us": Applauded and dismissed as a Gen Z climate activist (perspective from the field). *J Appl Res Child*. 2021;12(1):5. <https://doi.org/10.58464/2155-5834.1455>.
 37. Reyes MES, Carmen BPB, Luminarias MEP, Mangulabnan SANB, Ogunbode CA. An investigation into the relationship between climate change anxiety and mental health among Gen Z Filipinos. *Current Psychol*. 2021;42(9):7448–56. <https://doi.org/10.1007/s12144-021-02099-3>.
 38. Ross AD, Rouse SM. (Young) generations as social identities: The role of Latino*Millennial/Generation Z in shaping attitudes about climate change. *Polit Behav*. 2020;44:1105–24. <https://doi.org/10.1007/s11109-020-09649-8>.
 39. Bogueva D, Marinova D. Cultured meat and Australia's Generation Z. *Front Nutr*. 2020;7:148. <https://doi.org/10.3389/fnut.2020.00148>.
 40. Augustine K. Gen Z more optimistic about reversing the impacts of climate change. 2023. <https://civicscience.com/gen-z-more-optimistic-about-reversing-the-impacts-of-climate-change/>. Accessed 21 Jan 2024.
 41. YPulse (2023). The Biggest Problems European Gen Z and Millennials Are Facing in 2023. <https://www.ypulse.com/article/2023/08/31/we-the-biggest-problems-european-gen-z-and-millennials-are-facing-in-2023/> (Accessed 21 Jan 2024).
 42. Crawford I. Would stopping plastic pollution help with climate change? How do we do it?. 2022. <https://climate.mit.edu/ask-mit/would-stopping-plastic-pollution-help-climate-change-how-do-we-do-it>. Accessed 21 Jan 2024.
 43. Australia State of the Environment (2021). Land use. <https://soe.dcceew.gov.au/land/pressures/land-use> (Accessed 21 Jan 2024).
 44. Marinova D, Bogueva D. *Food in a planetary emergency*. Singapore: Springer Nature; 2022.
 45. Farber D. Climate perspectives across the generations. *Nat Resour J*. 2020;60(2):293. <https://digitalrepository.unm.edu/cgi/viewcontent.cgi?article=4100&context=nrj>. Accessed 21 Jan 2024.
 46. Swim JK, Aviste R, Lengieza ML, Fasano CJ. OK Boomer: A decade of generational differences in feelings about climate change. *Glob Environ Chang*. 2022;73:102479. <https://doi.org/10.1016/j.gloenvcha.2022.102479>.
 47. Moser B. Building sustainability into the German program: "Climate stories" in gen-ed German and the advanced curriculum. *Die Unterrichtspraxis*. 2021;54(2):257–70. <https://doi.org/10.1111/tger.12175>.
 48. American Psychological Association (2018). *Stress in America Generation Z*. American Psychological Association. <https://www.apa.org/news/press/releases/stress/2018/stress-gen-z.pdf> (Accessed 21 Jan 2024).
 49. Walker C. 'Generation Z' and second generation: an agenda for learning from cross-cultural negotiations of the climate crisis in the lives of second generation immigrants. *Child Geogr*. 2021;19(3):267–74. <https://doi.org/10.1080/14733285.2020.1817334>.
 50. Stokes B, Wike R, Carle J. *Global Concern About Climate Change, Broad Support for Limiting Emissions*. Pew Research Center. 2015. <https://www.pewresearch.org/global/2015/11/05/global-concern-about-climate-change-broad-support-for-limiting-emissions/>. Accessed 21 Jan 2024.
 51. Tyson A, Kennedy B, Funk C. Gen Z, Millennials Stand out for Climate Change Activism, Social Media Engagement with Issue. Pew Research Center. 2021. https://www.pewresearch.org/science/wp-content/uploads/sites/16/2021/05/PS_2021.05.26_climate-and-generations_REPORT.pdf. Accessed 21 Jan 2024.
 52. Mueller JT, Mullenbach LE. Looking for a white male effect in Generation Z: Race, gender, and political effects on environmental concern and ambivalence. *Soc Nat Resour*. 2018;31(8):925–41. <https://doi.org/10.1080/08941920.2018.1445331>.
 53. Wodika AB, Middleton WK. Climate change advocacy: Exploring links between student empowerment and civic engagement. *Int J Sust Higher Ed*. 2020;21(6):1209–31. <https://doi.org/10.1108/IJSHE-03-2020-0091>.
 54. Sofronski C. Rising temperatures, rising stress: the climate anxiety dilemma and its impact on Gen Z in the workplace. 2023. <https://apcoworldwide.com/blog/rising-temperatures-rising-stress-the-climate-anxiety-dilemma-and-its-impact-on-gen-z-in-the-workplace/>. Accessed 21 Jan 2024.
 55. McKinsey (2022). Addressing the unprecedented behavioral-health challenges facing Generation Z. McKinsey Healthcare Systems & Services Practice. <https://www.mckinsey.com/industries/healthcare/our-insights/addressing-the-unprecedented-behavioral-health-challenges-facing-generation-z/> (Accessed 21 Jan 2024).
 56. McKinsey (n.d.) Mind the gap: Should Gen Z care about Davos? <https://www.mckinsey.com/~media/mckinsey/email/genz/2022/05/31/2022-05-31b.html> (Accessed 21 Jan 2024).
 57. Carnegie M. Technology has given young people a louder voice than ever before. Gen Z are angry – and unafraid to speak up. 2022. <https://www.bbc.com/worklife/article/20220803-gen-z-how-young-people-are-changing-activism>. Accessed 21 Jan 2024.
 58. Tinkler J, Bousfield K. Disengaged or disillusioned? *Ethos*. 2019;27(2):20–3.
 59. Cooper, J. (2021). Unleashing the power of Gen Z. <https://www.edelman.com/insights/unleashing-power-gen-z> (Accessed 21 Jan 2024).
 60. Harris A, Wyn J, Younes S. Beyond apathetic or activist youth: 'Ordinary' young people and contemporary forms of participation. *Young*. 2010;18(1):9–32. <https://doi.org/10.1177/110330880901800103>.
 61. Miller KK, Shramko M, Brown C, Svetaz MV. The election is over, now what? Youth civic engagement as a path to critical consciousness. *J Adolesc Health*. 2021;68(2):233. <https://doi.org/10.1016/j.jadohealth.2020.10.033>.
 62. Crouch D. The Swedish 15-year-old who's cutting class to fight the climate crisis. *The Guardian*. 2018. <https://www.theguardian.com/science/2018/sep/01/swedish-15-year-old-cutting-class-to-fight-the-climate-crisis>. Accessed 21 Jan 2024.
 63. Taylor M, Watts J, Bartlett J. Climate crisis: 6 million people join latest wave of global protests. *The Guardian*. 2019. <https://www.theguardian.com/environment/2019/sep/27/climate-crisis-6-million-people-join-latest-wave-of-worldwide-protests>. Accessed 21 Jan 2024.
 64. Fridays For Future (FFF) (2022). *Strike Statistics*. Fridays for Future. <https://fridaysforfuture.org/what-we-do/strike-statistics/> (Accessed 21 Jan 2024).
 65. Alter C, Haynes S, Worland J. *Time 2019 Person of the Year: Greta Thunberg*. Time. 2019. <https://time.com/person-of-the-year-2019-greta-thunberg/>. Accessed 21 Jan 2024.
 66. Edwards AM. Inspire students by understanding past social movement success. *Child Educ*. 2021;97(4):77–80. <https://doi.org/10.1080/00094056.2021.1951571>.
 67. Morris M. *Climate change, social media, and Generation Z*. Master's thesis. Pepperdine University. 2020. <https://digitalcommons.pepperdine.edu/cgi/viewcontent.cgi?article=2182&context=etd#:~:text=For%20Gen%20%2C%20social%20media,equality%2C%20feminism%2C%20and%20poverty>. Accessed 21 Jan 2024.

68. Mezgaile A, Grinberga K, Singh N, Livina A. A study on youth behavior towards the north vidzeme biosphere reserve in Latvia. *J Environ Manag Tour*. 2021;12(5):1171–8. [https://doi.org/10.14505/jemt.v12.5\(53\).02](https://doi.org/10.14505/jemt.v12.5(53).02).
69. Jung J, Petkanic P, Nan D, Kim J-H. When a girl awakened the world: A user and social message analysis of Greta Thunberg. *Sustainability*. 2020;12(7):2707. <https://doi.org/10.3390/su12072707>.
70. Bogueva D, Marinova D, Wäechter N, Tekiner IH. What worries them? The societal concerns of Generation Z. In: Seemiller C, Grace M, editors. *Gen Z around the world: Understanding the global cohort culture of Generation Z*. Bingley: Emerald Publishing; 2024. p. 119–127.
71. Barrón NG, Sibylle G, Huffman G. Student engagement and environmental awareness: Gen Z and ecocomposition. *Environ Humant*. 2022;14(1):219–32. <https://doi.org/10.1215/22011919-9481528>.
72. Beasy K, Lucas C, Mocatta G, Pec G, Kelly R. How well does the new Australian Curriculum prepare young people for climate change?. *The Conversation*. 2022. <https://theconversation.com/how-well-does-the-new-australian-curriculum-prepare-young-people-for-climate-change-183356>. Accessed 21 Jan 2024.
73. Evans M. Sir David Attenborough thinks his generation 'muffed' chance to save natural world: 'The world belongs to young people'. 2020. <https://metro.co.uk/2020/09/21/sir-david-attenborough-generation-muffed-chance-natural-world-13305292/>. Accessed 21 Jan 2024.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.