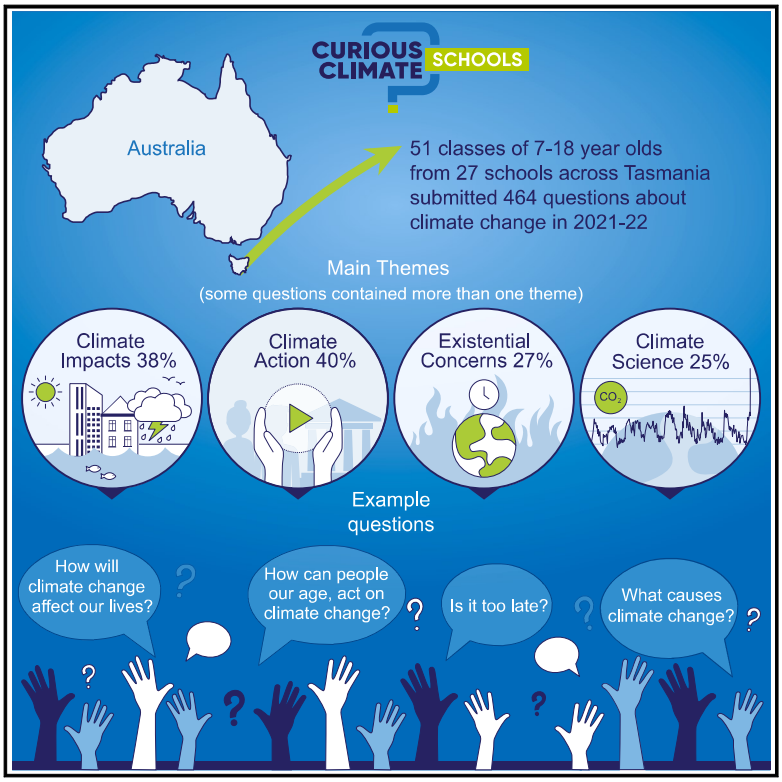
One Earth

Analysis of children's questions on climate change reveals that they are most concerned about how to take action

Graphical abstract



Highlights

- Of all aspects of climate literacy, children see climate action as most important
- Children identify climate change as an existential threat in their lifetimes
- Climate education should be holistic, empathetic, and empowering
- Children should be included in decision-making that will affect their futures

Authors

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In brief

The lives of the current generation of children are being shaped by climate change, but their opinions and concerns are not well understood or accounted for in decision-making. Our study of children's questions about climate change investigates what aspects of climate literacy are prioritized by 7 to 18 year olds. Climate action was the most frequently occurring theme in children's questions, followed by queries about the impacts of climate change and expressions of existential concern about the future.

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Article

Analysis of children's questions on climate change reveals that they are most concerned about how to take action

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SCIENCE FOR SOCIETY Climate change will affect the wellbeing of today's children across their whole lives. Children have a right to information and a right to have their opinions taken into account when adults are making decisions that affect them. But science, industry, and government have so far failed to engage with the voices and opinions of the generation that will bear the brunt of these decisions. We asked 1,500 children to tell us what they wanted to know about climate change. Their questions show that climate action is their greatest concern—they want to know what can be done and what is preventing rapid action. Many children see climate change as posing an existential threat to the planet within their own lifetimes, and this leads to feelings of anxiety, grief, despair, and concern and a search for hope and reassurance. Our research reveals a need for holistic climate change education in schools and greater opportunities for children to be involved in shaping the future they will inherit.

SUMMARY

Children across the world are facing physical, emotional, and social impacts of climate change. Despite burgeoning scientific and political climate discourse, the voices and opinions of children are underrepresented, as previous research has focused on the opinions of adults. This lack of representation contributes to feelings of disempowerment and betrayal. We investigate children's priorities for climate knowledge, reporting on questions asked by approximately 1,500 Australian school students as part of a climate literacy engagement project. They reveal remarkable depth of consideration about climate change, with a stronger focus on impacts and action than on scientific causes. "What can we do?" was the core concern of 40% of questions, which often emphasized individual responsibility. Urgency and frustration were evident in questions about climate impacts posing an existential threat to life. Findings demonstrate the importance of considering children's valid concerns when making decisions that affect their education, well-being, and future.

INTRODUCTION

Every day, more children are discovering that they are living in a climate crisis. Many are experiencing anxiety that humanity and all life on Earth are doomed.[1,2] Young people are disproportionately affected by climate change,[3] the impacts of which will affect the health, wealth, well-being, life choices, and career trajectories of today's children across their whole lives.[4,5] Globally, a survey of 10,000 young people in ten countries indicates that 84% of young people aged 16–25 are at least moderately worried about climate change, reporting feelings of sadness, anxiety, powerlessness, and guilt.[1] In Australia, 43% of children aged 10–14 are worried about the future impact of climate change, and one in four is so troubled about the state of the world they believe it will come to an end before they grow up.[6] There is evidence of an emerging intergenerational divide, as young people report feeling frustrated, unlistened to, and betrayed by older generations when talking with them about climate change.[2,7]

The United Nations Convention on the Rights of the Child[8] states that children have a right to information and a right to have their opinions taken into account when adults are making decisions that affect them. However, climate discourse across science, industry, and government does not actively engage with the voices and opinions of the generation that will bear the brunt of these decisions. As Gibbons[5] (p. 23) notes, "children's voices are scarcely heard, and their concerns are strangely invisible in climate policy dialogues." Governmental narratives tend to bracket children as requiring protection and education, positioning them as passive and marginal actors whose interests require adult interpretation and representation.[9] Where climate change is taught in schools, it is primarily represented as a scientific and environmental issue without focus on its sociopolitical causes and challenges.[10] This draws focus away from the current and future rights of children to a safe climate and ignores their views and feelings about the climate crisis. There is a need for policymakers and corporate decision-makers to listen to children's questions and concerns about climate change and for schools to enable conversations about social justice aspects of climate change.[11]

Literature on children's attitudes to climate change is relatively limited but is a growing research area. Methodological challenges of this research mean that studies tend to focus either on those in their late teens or on small numbers of children in school settings.[12] Previous studies, in UK and United States contexts, have identified children's tendency to see climate change as a spatially and temporally distant threat,[13,14] but this is often somewhat paradoxically coupled with dramatic expectations of catastrophic futures.[6,13,15–17] Several studies have also identified children's propensity to strongly individualized understandings of responsibility for climate action.[14,15,17,18]

An analysis of British 10 to 12 year olds' questions about climate change found that they see climate change as both a current and future threat but as geographically distant, some drawing on science-fiction imagery to describe imagined futures in which there might be a need to "evacuate Earth."[13] Letters sent by children to the incoming (then undetermined) President of the United States in 2016 contained evidence of three types of narratives about climate action: a narrative situating climate change as a political problem demanding policy solutions including a shift away from capitalist norms, a solutions-focused narrative implying the need for individual and collective, financial and technological solutions, and "a discourse of doom" reflecting a loss of hope and anxiety about the impacts of climate change.[17] However, concern about climate change is by no means universal in children.[12] For example, most school students surveyed in the western United States see climate change as a geographically and temporally distant threat.[14]

Children's climate discourses can, to some degree, be expected to reflect the broader discourses of the societies in which they live.[19] That children in the Global North (including Tasmania, Australia) tend to see climate change as a distant threat may be evidence that they have less direct experience of climate impacts than those in the Global South. It may also be evidence of social control of what is considered appropriate knowledge for children through political mediation of climate discourse. Social norms around what is considered appropriate for discussion in various life contexts often exclude climate change,[20] and children who challenge norms of climate silence risk being labeled either as alarmists or as unwitting pawns of adult political activists.[21] Such social silencing of climate conversations limits our collective ability to discuss pathways to alternative futures, leading to a situation in which "the end of the world" is more easily imaginable than alternatives to fossil fuel dependency or capitalism.[22]

Social hierarchies perpetuated through family, school, and media norms support children making individual choices within existing systems but also delegitimize collective action that might disrupt these systems.[15] This tension is described by Karsgaard and Davidson,[18] who document a participatory research project involving 99 school students from 13 countries that led to the presentation of a white paper on childhood climate citizenship to the IPCC. The authors found that while the children participating in their project most often saw climate change as an issue of justice, they were limited in their ability to imagine different ways of dealing with this issue by the dominant framings of individualized responsibility and government leadership. Despite their age, children felt responsible for their participation in economic systems that damage the environment: "When describing how they might act to address climate change and climate injustices, students tended toward individualist behaviors in response to a deep sense of guilt over consumptive practices"[18] (p. 83).

In defiance of pressure to conform to individualist expectations and in the absence of a democratic right to vote, some children have sought to have their voices heard by self-organizing to demand climate action and to express their discontent with existing opportunities for climate education.[23–27] As part of a global school strike in 2019, 1.4 million young people in 128 countries walked out of school systems that they felt were failing to address their present and future concerns.[28,29] This catalyzed the growth of many youth-led climate action groups across the world.[30] A number of these groups have made inroads into political and legal fora to challenge governments to act on climate change, while others practice disruptive forms of protest.[31,32] Such political representation for committed children and young people, while important, is not an opportunity that is equitably accessible for all.[33] Children lack opportunities to have their opinions on climate heard in schools, where most teachers feel ill-equipped to teach the subject[34] and most curricula structurally limit the ability of teachers to do so holistically.[35–37] It is therefore vital to ensure that children are given the chance to learn, to ask questions, to be heard, and to be empowered to participate in practical and political climate action through universal access to climate education in schools.

Here, we report on the results of a study on children's priorities for climate literacy that elicited questions on climate change from 51 school class groups of children aged 7–18 (see Figure 1 for examples). Questions were collected over 2 years as part of an ongoing climate literacy project that aims to listen to children's concerns and to empower them to understand and act on climate change. We found that the children's questions most often asked what can, and is, being done about climate change, with a strong focus on what they themselves

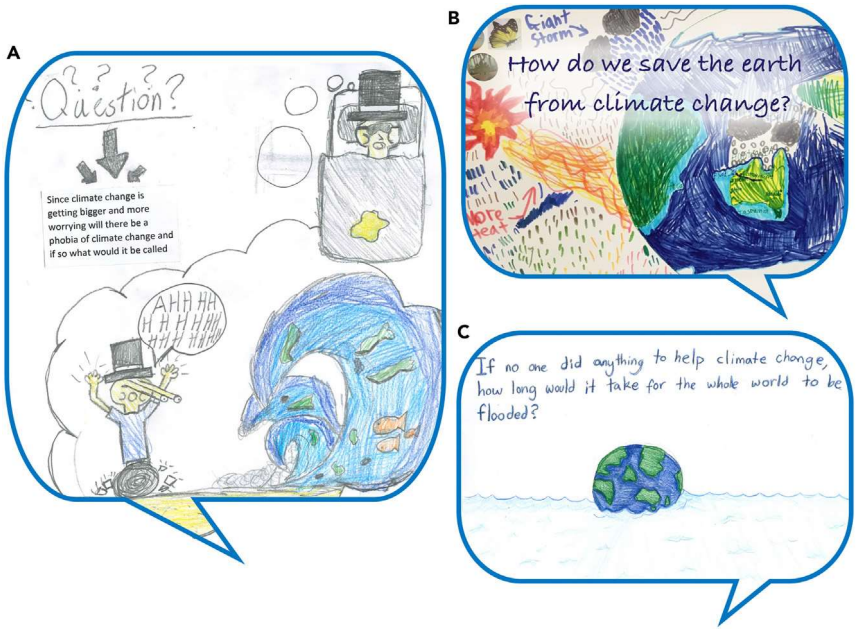

Figure 1. Examples of picture questions submitted to Curious Climate Schools
(A and C) Submitted by Princes Street Primary School, grade 5/6, 2022.
(B) Submitted by Margate Primary School, grade 3, 2021.

can do. Other key themes were questions about the impacts of climate change, worries about the future, and inquiries about the science of climate change. We outline the implications of this research for climate literacy education and suggest that young citizens deserve to be listened to and involved in political decision-making about their futures.

RESULTS

Methods summary

In this study, we explore children's climate attitudes and understandings through a detailed thematic analysis of 464 questions about climate change submitted to Curious Climate Schools in 2021 and 2022 by approximately 1,500 primary and high school students aged 7–18 from 51 classes across the state of Tasmania, Australia. We describe the main themes identified in children's questions from 2021 to 2022 and the types of issues they comprise. We also examine the spatial and temporal dimensions in which questions are framed. We then discuss the implications of these findings for the inclusion of children's voices in social and political decision-making and the prospects for climate education that empowers children to meaningfully engage in these fora.

Questions were assigned to multiple codes according to the specific concepts included in them. They were then grouped by sets of codes into four major thematic categories: climate impacts, climate actions, climate science, and existential concerns (Figure 2). Because questions contained multiple ideas and often subquestions, these themes and categories, to some extent, overlap (Figure 3). The full dataset is available in the supplemental information. All percentages reported below are of the whole dataset, rounded to the nearest whole number. See the experimental procedures section for full methods.

Climate impacts

The impacts of climate change were discussed in 38% of children's questions. One-tenth of the total number of questions asked about impacts on places, most notably Earth (6%), e.g., "With the rate of climate change, what will the earth be like when I'm an adult?" Children asked about impacts on their home state of Tasmania (2%) and on Antarctica (2%), e.g., "What does the melting of glaciers in Antarctica mean for Tassie [Tasmania] and our climate?" These

Figure 2. The four main themes described in children's questions, with examples of questions from each theme

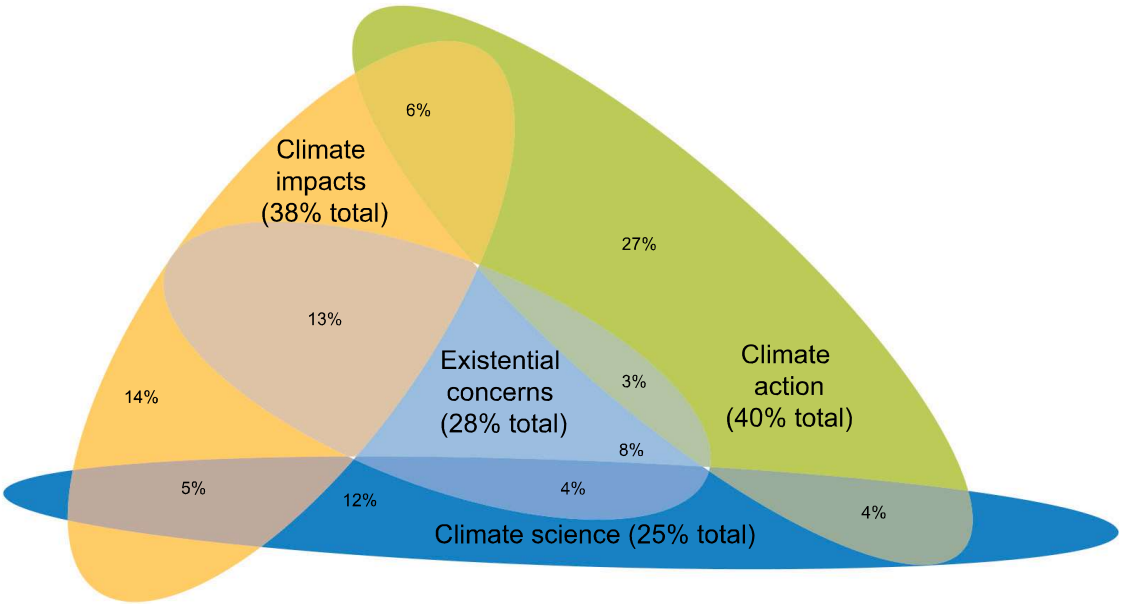

Figure 3. Euler diagram showing the proportions of questions referring to the four main themes and the co-occurrence of themes within questions

The three three-way interactions are not represented proportionally but are each 1%. The Euler diagram was created using eulerr: Larsson, J. (2021). eulerr: Area-Proportional Euler and Venn Diagrams with Ellipses. R package v.6.1.1.

questions demonstrate children's understanding of the global scale of the climate crisis and their concern about places close to home (Tasmania is a "gateway" to Antarctica).

The impacts of climate change on humans accounted for 12% of questions, in particular about the way we live (4%), for example, "Will climate change make us live elsewhere? e.g., underwater or in space?", health (2%), and food (2%).

Impacts on animals and biodiversity, such as the possibility of extinctions, were the subject of 9% of questions, including "What species may become extinct due to climate change, which species could adapt to changing conditions and have we already seen this begin to happen?" Approximately 7% of questions asked about ice melting and/or sea level rise, while 3% asked about extreme weather or disasters and 2% about impacts on the atmosphere.

Climate actions

Action on climate change was the most frequent theme, discussed in 40% of questions. While 13% asked open questions about what kinds of action are needed, 9% focused on the challenges inherent in taking action, e.g., "How would you make rapid climate improvements without sacrificing industry and finance?"

Around 16% of questions asked about, or implied, who was responsible for climate action. Of these, the largest group (6% of all questions) singled out governments or politicians, e.g., "How can we encourage government to take action on climate change?", with most focused on Australian politicians and less than 1% discussing the responsibilities of other countries. Children asked about collective responsibility of societal groups including schools, communities, whole states, and countries in 5% of questions. A slightly lower proportion (4%) asked about the responsibility of individuals, and 3% focused on young people, including themselves as individuals: "What can I do as a 12-year-old to help the planet, and why will these actions help us?" Some of these questions (4%) implied that people with knowledge of climate change have responsibility to act, e.g., "If the world knows about climate change, why has not much happened?" This extended to the responsibility of workers—"If factory workers and other people who work in industries … are aware that they pollute the air and water, then why do they keep producing the products?"—but, notably, almost never to the responsibility of greenhouse-gas-emitting corporations (0.2%).

Questions suggesting strategies or discussing action by specific sectors accounted for 20% of questions. This included strategies about energy generation such as stopping using fossil fuels (3%) and moving to renewable energy (2%) or nuclear power (1%). Policy and governance were suggested as vital to action in 5% of questions. Other questions suggested action related to food, agriculture, or fisheries (3%); the climate credentials of cars and electric vehicles, for example, "Are electric cars good if they get charged by coal powered electricity?" (2%); plastics, waste management, and recycling (2%); action on manufacturing (1%); and finance (1%). Only a small number of questions asked if humans could adapt to climate change (2%).

Existential concerns

Students raised existential concerns, relating to worries about being able to stop or limit climate change and what will happen in the future if this does not occur, in 27% of questions. These were characterized by uncertainty about the future and often focused on catastrophe. The largest group of these questions (15%) asked for predictions of future events, e.g., "Will all the

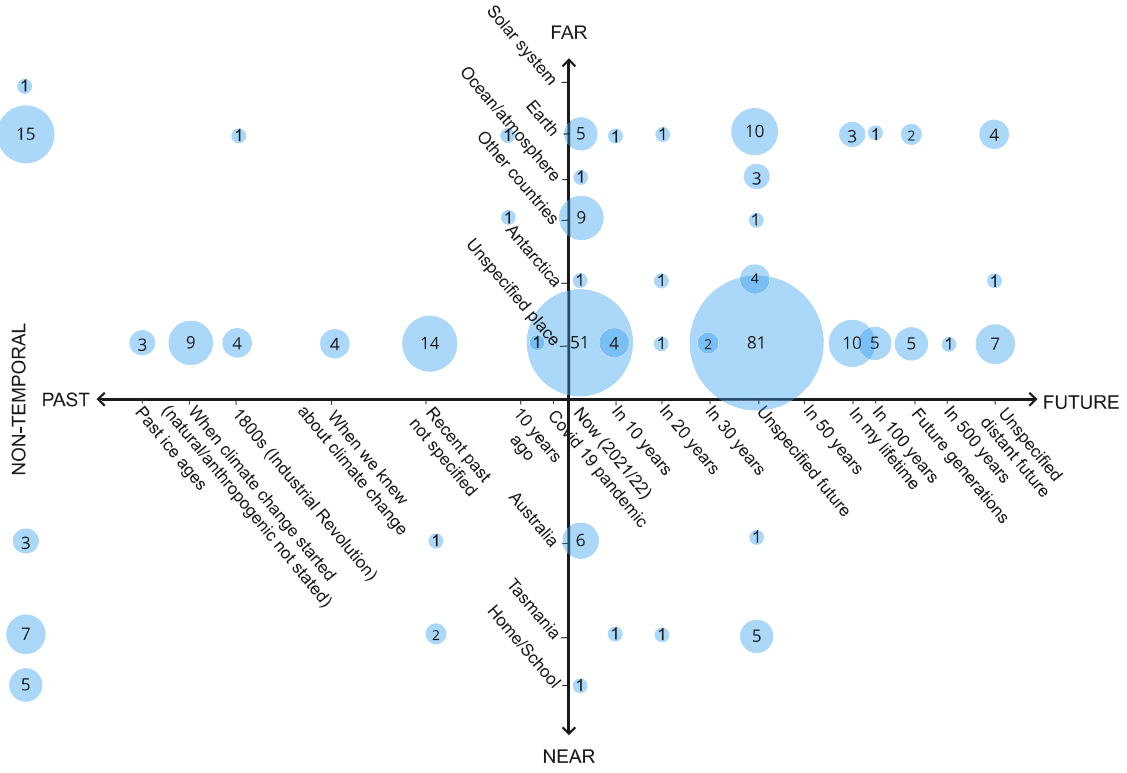

Figure 4. Number of questions with spatial and/or temporal dimensions
The bubble size is proportional to the number of questions within each spatiotemporal category.

reefs die?" Questions asked about how long we have before it is "too late" (7%), e.g., "How long before climate change will destroy the earth?" Nearly 4% asked if the effects of climate change can be reversed, and 2% asked if they can be stopped. Some 5% of questions implied a doomed planet or doomed humanity—e.g., "How long will we be able to survive on our planet if we do nothing to try to slow down/reverse climate change?"

Climate science

Scientific questions about climate change made up 25% of questions. The largest group of these (11%) were questions about the causes of climate change and the physical processes involved—for example, "What causes the earth to get hotter due to climate change?" Hypotheticals, or "what if" questions, such as "Would our world be the same now if the Industrial Revolution hadn't happened?" comprised 6%. Other questions (3%) asked about scientific evidence, for example, "How do they know the climate and percentage of gases, such as methane, in the 1800s?" Nearly 2% of questions posed counterarguments, such as alternative climate scenarios, e.g., "Is it possible for the Earth to get colder instead of warmer? What would have to happen for this to occur? What are the chances of another ice age and what would the effects be?" A small number (1%) asked about how the ozone layer might be implicated in climate change.

Spatial and temporal framings

Questions with spatial and temporal framings were coded according to their distance in time or space from students' homes in the present, as can be seen in Figure 4. A majority of questions focused on future events at distances beyond Australia or in places that were unspecified. The largest group of questions referred to an unspecified future time that most often appeared to be within students' lifetimes. The second largest group referred to what can be done now. In terms of spatial scale, 9% of questions in total are situated at Earth scale, compared to just 1% of questions being at the scale of school or home, 3% at local state (Tasmania) scale, and 3% at national (Australia) scale.

Differences between primary and secondary students' questions

A comparison of the proportion of questions in each theme asked by students from primary versus secondary schools (Table 1) shows that the relative numbers of questions on climate

Table 1. Thematic breakdown by primary/secondary school

	Percentage of questions from primary schools, N = 172 (%)	Percentage of questions from secondary schools, N = 292 (%)
Climate impacts	45	34
Climate action	37	41
Existential concerns	28	26
Climate science	23	27

In Australia, primary school includes children up to age 12, and secondary school includes young people from age 13 to 18.

science and expressing existential concerns are consistent across age groups. However, primary school students are more likely to ask questions about climate impacts, and less likely to focus on climate action, than older students.

DISCUSSION

The breadth and depth of children's questions indicate sophisticated capacities to engage with and inform social and political discourses about climate change. Listening to and answering children's questions disrupts dominant social hierarchies of adult power that marginalize young voices and legitimizes the active and collective role of children in seeking transformative socioecological change.[7,21] Children's questions about futures and impacts indicate an interest in who is responsible for decision-making about things that impact the conditions of their own lives. Further, their questions also probe for ways to respond to climate change outside dominant framings of individualized and government leadership. This is evident, for example, in the question "How do we make a vacuum car to suck up car fumes and fire gases?" Empowered to think more freely, children indicate a willingness to seek alternative, innovative actions to respond to the wicked problem of climate change.

Children's questions indicate significant uncertainty about the future, in common with previous research.[13,14,38] Revealing their emotional landscapes, children's questions about existential concerns reflect anxiety, grief, despair, concern, and a search for hope and reassurance. For example, questions such as "People are aware of climate change, but do nothing. So, what hope do we have? Not many people are willing to make a difference. We can't turn around from this now" indicate an affective engagement of children in their questions about climate change. Temporal framings of an uncertain future within their lifetimes are consistent with the findings of Hickman et al.'s[1] global survey and Zummo et al.'s[17] discourse of doom narrative. This uncertainty contributes to children's loss of ontological security and a sense of overwhelm. As did the British children in Lee and Barnett's[13] study, some children in this study explicitly or implicitly drew upon images and themes from speculative fiction to try to imagine their future world. For example, "In 'Cloudy with a Chance of Meatballs', we saw some unusual rainfall patterns! What changes to rainfall can be predicted due to global warming?" and "Will climate change make us live elsewhere? e.g.,: underwater or in space?" There was a notable overlap (13%) between climate impacts and existential concerns in our results. It is possible that seeking clarity on climate impacts may be a way children try to address their existential concerns. Asking questions about the scientific certainty about the causes of climate change, "what if" scenarios, and projected impacts could also be understood as being motivated by significant concern about existential threats to life.

Unlike previous studies, children's questions suggested that they do not see climate change as distant in space or time. While many questions were framed at a global scale, concerns about current impacts on people, animals, and places that they care about often tended to follow the form "what has happened already, and what further impacts can we expect?" Younger children in particular, possibly still coming to terms with what climate change means for the world around them, tended to focus strongly on impacts. However, the strong emphasis on existential concerns across all ages, and climate action in 41% of questions by secondary students, suggests that climate change is no longer an abstract topic for these children—they perceive a real and present threat to their lives that demands a swift and adequate response. It is possible that this reflects a growing engagement with climate change, either through its growing prominence in public discourse or through movements led by young people, such as the School Strikes for Climate.

Children, particularly those in older age groups, recognize the need for climate action and are also aware of its inherent challenges. Questions about responsibility for action were often related to why certain groups in society who might be expected to take action were not doing so or not doing enough. Governments were singled out for the most criticism in this respect as the ultimate legislative and policy-setting authorities. This may reflect a strong focus on government in educational curricula. In contrast, corporate and industrial interests were only once mentioned as having explicit responsibility for climate action—and then only alongside government. This could be attributed to a lack of knowledge among children about the power and influence of large corporations and a lack of focus on this subject in school curricula.

Instead of questions focusing on system or corporate responsibility, we found a strong emphasis on individual responsibility to act, including the responsibility of children themselves. This finding is in common with previous studies with children[14,15,17,18] and with a similar project involving adults in Tasmania.[39] Questions suggested a moral imperative for action by those who are not ignorant of climate change and a palpable sense of betrayal at people's lack of response despite their knowledge. Children's questions presented a disjuncture between the catastrophic scale of the existential threat described and the limited scale of responsibility and action they could imagine in response. This finding makes clear the need for climate education that enables a holistic understanding of the wicked problem of climate change and deliberative consideration of the entire spectrum of future pathways. A focus on climate action could be empowering for many children, but it should be recognized that children are not responsible for the climate crisis and should not be responsibilized as potential saviors—pressure to constantly and consistently act in a climate-positive way can contribute to further climate distress.[9] While children's questions predominantly framed responsibility at an individual level, collective responsibility of schools and the national responsibility of Australia were also highlighted. The inference that children see themselves as part of school communities with a responsibility to act on climate change is important for education policy.

It should be noted that there are limitations to the generalizability of findings of this study, as participation was voluntary and limited to Tasmanian children. More information on potential selection biases can be found in the experimental procedures.

Conclusion

Children are excluded from climate discourse through a lack of climate literacy education[36] and limited opportunities to be involved in decision-making as citizens.[40] The UNESCO[41] Global Education Monitoring Report found that half of all school curricula globally do not explicitly mention climate change

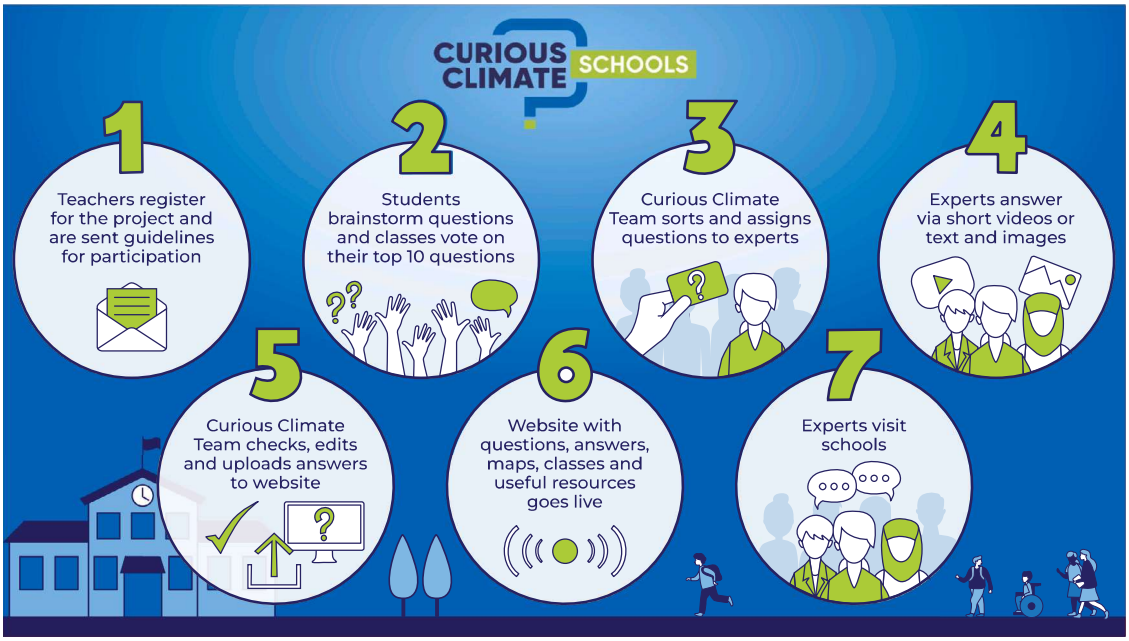

Figure 5. The Curious Climate Schools engagement process
Reproduced from https://www.curiousclimate.org.au/schools.

anywhere in their content. Climate change education for young people, globally, has tended to focus on scientific knowledge rather than social or political aspects of climate change.[10] Our analysis of questions submitted to Curious Climate Schools indicates that while there is a need for education about the physical causes and processes of warming, children are more concerned with what climate change means for them and the things they care about and about how this problem can be solved for the future of the whole planet. Schools that take on the challenge of listening to students' voices, providing support for climate distress, and helping them shape collective climate action within their school communities have a double opportunity: to help children learn the strategies they need to manage feelings of climate anxiety and to empower young voices in public climate discourse.

EXPERIMENTAL PROCEDURES

Resource availability

Lead contact

Requests for further information should be directed to the lead contact, Chloe H. Lucas (chloe.lucas@utas.edu.au).

Materials availability

This work did not produce any novel materials.

Data and code availability

The data are available in an online data repository, accessible at https://dx.doi.org/10.25959/mx78-zb37. The original questions posed and the answers provided can be viewed in aggregate form at http://www.curiousclimate.org.au/schools.

Participants

Curious Climate Schools is a climate literacy engagement project in the state of Tasmania, Australia.[42] Teachers register their classes to participate and receive detailed instructions about how to facilitate a "climate questions" brainstorming session (see supplemental information). These guidelines specify how teachers should openly encourage classes to think about climate change in its broadest sense across political, environmental, social, technological, legal, and economic spheres. Teachers lead a brainstorming discussion, after which students write down all the questions about climate change that they can think of on a set of index cards. The class then groups the questions into sets of categories and votes on its top ten questions (see Figure 5). Each class submits its top ten questions to the Curious Climate Schools website. Teachers consent for their classes' questions to be published online via the Curious Climate Schools website. These questions are in the public domain and can be found at https://www.curiousclimate.org.au/schools. Advice from the Institutional Chair of Ethics was sought to address ethical considerations associated with the use of publicly available materials generated through the climate literacy project Curious Climate Schools for research purposes. While the Chair advised that application for institutional ethics approval was not necessary in this case, we adopted ethical principles in the conduct of the research through protecting the identities of teachers and students in the presentation of student questions.

Across the 2 years represented in this dataset, 51 class groups from 27 schools around Tasmania submitted questions (see Table 2). Of these schools, 18 were government and nine private schools, 20 in regional urban settings, six in rural settings, and one online. There was a wide range of socioeconomic circumstances across these schools, with six schools in the lowest quartile of educational advantage in Australia and nine in the top quartile. Students' ages ranged from 7 to 18 years, with the majority of participants aged between 10 and 16 years. While this represents a broad and diverse sample of Tasmanian children, it is subject to some biases. Registration was voluntary, and teachers were more likely to register their classes if the teacher had some level

Table 2. Participating schools that submitted questions

School	Sector	School years	ICSEA percentile[a]	Location	Participating students' age range	No. classes submitting questions
Cambridge Primary School	government	K–6	65	inner regional	9–11	1
Campbell Town District High School	government	K–12	13	outer regional	15–16	2
Clarence High School	government	7–12	54	inner regional	14–16	3
Deloraine Primary School	government	K–6	24	outer regional	10–12	1
Department of Education Action Pact Extension Program	government	5–6	N/A	online	8–12	1
Devonport High School	government	7–12	21	inner regional	10–12	2
Dominic College	private	prep–10	55	inner regional	12–14	1
Fahan School	private	prep–12	95	inner regional	11–12	2
Hobart College	government	11–12	69	inner regional	17–18	1
Lambert School	private	prep–10	50	inner regional	14–16	2
Launceston Church Grammar School	private	prep–12	86	inner regional	15–16	1
Lenah Valley Primary School	government	K–6	77	inner regional	8–9	1
Margate Primary School	government	K–6	55	inner regional	7–11	3
Peregrine School	private	prep–10	77	outer regional	12–16	1
Princes Street Primary School	government	K–6	97	inner regional	10–12	3
Reece High School	government	7–12	14	inner regional	13–14	2
Riverside High School	government	7–12	54	inner regional	12–16	2
South Arm Primary School	government	K–6	51	outer regional	9–12	1
South Hobart Primary School	government	K–6	94	inner regional	10–12	3
St Mary's College, Hobart	private	prep–12	74	inner regional	11–16	7
St Michael's Collegiate School	private	prep–12	91	inner regional	12–16	2
St Virgil's College	private	prep–10	57	inner regional	13–14	1
The Friends' School	private	prep–12	95	inner regional	10–13	2
Triabunna District School	government	K–12	10	outer regional	14–16	2
Ulverstone Secondary College	government	11–12	14	outer regional	15–16	1
Waimea Heights Primary School	government	K–6	94	inner regional	8–10	1
West Launceston Primary School	government	K–6	65	inner regional	8–10	2

[a]ICSEA, created by the Australian Curriculum, Assessment and Reporting Authority (ACARA), is a scale that identifies the socioeducational advantage of a school. Key factors in students' family backgrounds (parents' occupation, school education, and non-school education) have an influence on students' educational outcomes at school. The ICSEA percentile describes how educationally advantaged a school is in comparison to other schools in Australia: for example, a school with an ICSEA percentile of 15 is more disadvantaged than 85% of Australian schools and more advantaged than 15%. School information reproduced in this table is copyright ACARA 2009 to present unless otherwise indicated. This material was downloaded from the ACARA website (www.acara.edu.au, accessed May 30, 2023) and was modified for clarity. The material is licensed under CC BY 4.0 (https://creativecommons.org/licenses/by/4.0/). ACARA does not endorse any product that uses ACARA material or make any representations as to the quality of such products. Any product that uses material published on this website should not be taken to be affiliated with ACARA or have the sponsorship or approval of ACARA. It is up to each person to make their own assessment of the product.

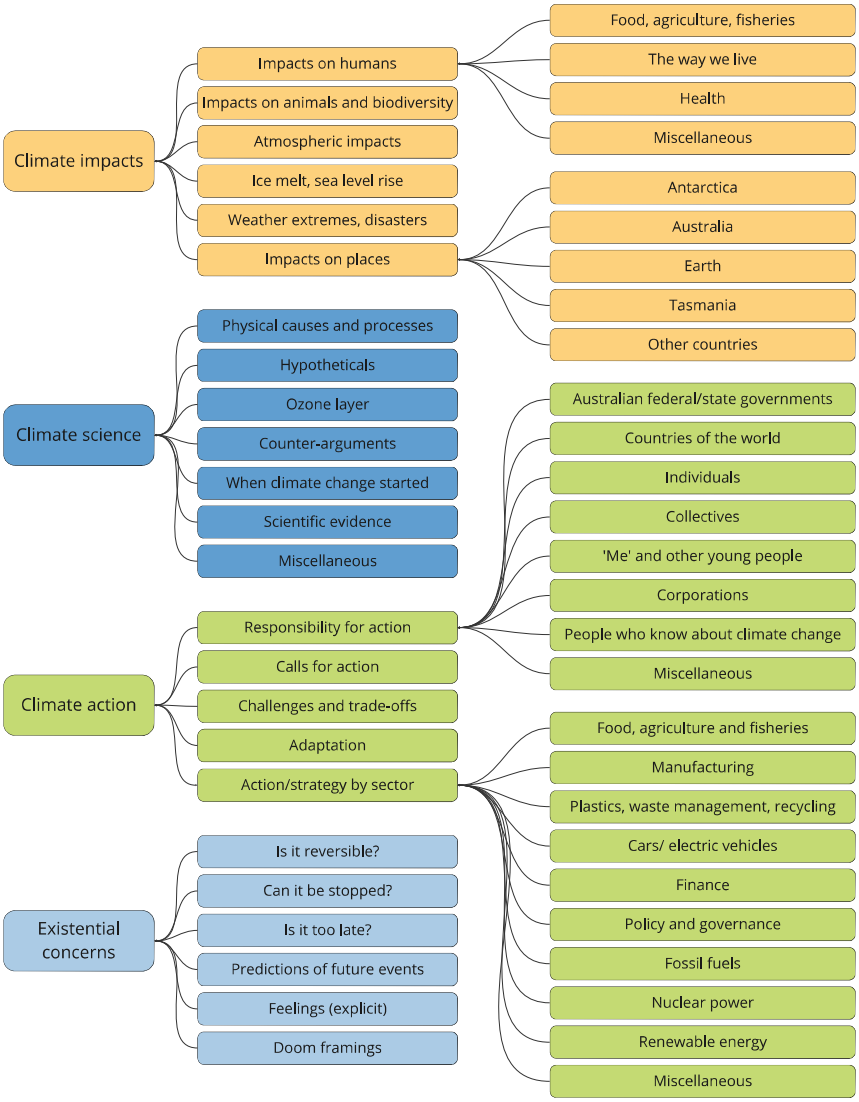

Figure 6. Coding hierarchy
Codes and sub-codes included under each theme.

of interest in climate change. Challenges of time and ability to fit participation into already packed time tables meant that it was harder for high school students to participate. Siloing of subjects and limitations of the Australian curriculum also contributed to this challenge. In 2021, 269 questions were asked by 28 classes, and in 2022, 195 questions were asked by 23 classes. Of the total 464 questions, 460 were "unique" questions not asked using exactly the same words more than once. Many of the questions were complex and included multiple sub-questions. A large number also had embedded assumptions or made use of particular concepts or framings of climate change.

Analysis

Detailed thematic analysis of questions[43] was undertaken by the lead author and checked by authors two and three. Thematic categories (hereafter "codes") were identified inductively through immersion in the material, with codes generated for any information contained in the question—such as who it pertained to, what it described, in what time frame, and where. Each question was assigned to one or more codes in NVivo based on whether it included words or phrases relevant to each code. Coding aimed to be comprehensive so that as many subjects, meanings, and forms of query as possible were categorized. Each question was therefore assigned to multiple codes. After the questions were initially coded, a second round of checking and re-coding was done to ensure that each question was checked against each code. A third round of checking ensured that codes did not duplicate information, collapsed codes with less than three questions into higher-level codes where possible, and ensured that each code name clearly represented a shared property of the questions coded to it and that each question was coded to all relevant codes. These codes were then thematically grouped into four overarching themes, climate impacts, climate actions, existential concerns, and climate science, and two overarching framings, temporal and spatial. For example, "How will Tasmania stop the waters rising" was coded under "ice melt or sea level rise" in the theme climate impacts and under "calls for action," "responsibility for action/Australian state/federal governments," and "responsibility for action/collective" in climate action. As a result, it is counted once for each of the major themes climate impacts and climate action. It is coded as having a spatial framing of Tasmania and a temporal framing of unspecified future. Figure 6 shows the final coding scheme. An additional eight questions (submitted late by one class) were coded after the themes had been identified.

SUPPLEMENTAL INFORMATION

Supplemental information can be found online at https://doi.org/10.1016/j.oneear.2024.02.017.

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AUTHOR CONTRIBUTIONS

Conceptualization, all authors; methodology, C.H.L., C.A.E.-J., and G.M.; investigation, all authors; formal analysis, C.H.L.; validation, C.A.E.-J. and G.M.; writing – original draft, C.H.L. and C.A.E.-J.; writing – review & editing, all authors.

DECLARATION OF INTERESTS

The authors declare no competing interests.

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REFERENCES

1. Hickman, C., Marks, E., Pihkala, P., Clayton, S., Lewandowski, R.E., Mayall, E.E., Wray, B., Mellor, C., and van Susteren, L. (2021). Climate anxiety in children and young people and their beliefs about government responses to climate change: a global survey. Lancet Planet. Health *5*, e863–e873. https://doi.org/10.1016/S2542-5196(21)00278-3.
2. Jones, C.A., and Davison, A. (2021). Disempowering emotions: The role of educational experiences in social responses to climate change. Geoforum *118*, 190–200. https://doi.org/10.1016/j.geoforum.2020.11.006.
3. Sanson, A.V., Van Hoorn, J., and Burke, S.E.L. (2019). Responding to the Impacts of the Climate Crisis on Children and Youth. Child Dev. Perspect. *13*, 201–207. https://doi.org/10.1111/cdep.12342.
4. UNICEF (2021). The Climate Crisis Is Also a Child Rights Crisis.
5. Gibbons, E.D. (2014). Climate change, children's rights, and the pursuit of intergenerational climate justice. Health Hum. Rights *16*, 19–31.
6. Tucci, J., Mitchell, J., and Goddard, C. (2007). Children's Fears, Hopes and Heroes: Modern Childhood in Australia.
7. Jones, C.A., and Lucas, C.H. (2023). "Listen to Me!" Young People's Experiences of Talking about Emotional Impacts of Climate Change. PRE-PRINT.
8. United Nations. (1989). The Convention on the Rights of the Child.
9. Jones, C.A., Davison, A.G., and Lucas, C.H. (2023). Innocent heroes or self-absorbed alarmists? A thematic review of variety and effects of storylines about young people in climate discourse. WIREs Climate Change *Manuscript*, 1–17. https://doi.org/10.1002/wcc.853.
10. Siperstein, S. (2015). Finding Hope and Gratitude in the Climate Change Classroom. Journal of Sustainability Education *10*, 6.
11. Stapleton, S.R. (2019). A case for climate justice education: American youth connecting to intragenerational climate injustice in Bangladesh. Environ. Educ. Res. *25*, 732–750. https://doi.org/10.1080/13504622.2018.1472220.
12. Lee, K., Gjersoe, N., O'Neill, S., and Barnett, J. (2020). Youth perceptions of climate change: A narrative synthesis. Wiley Interdiscip Rev Clim Change *11*, 1–24. https://doi.org/10.1002/wcc.641.
13. Lee, K., and Barnett, J. (2020). 'Will polar bears melt?' A qualitative analysis of children's questions about climate change. Publ. Understand. Sci. *29*, 868–880. https://doi.org/10.1177/0963662520952999.
14. Busch, K.C., and Ayala Chávez, R. (2022). Adolescent framings of climate change, psychological distancing, and implications for climate change concern and behavior. Clim. Change *171*. 21-19. https://doi.org/10.1007/s10584-022-03349-4.
15. Threadgold, S. (2012). "I reckon my life will be easy, but my kids will be buggered": Ambivalence in young people's positive perceptions of individual futures and their visions of environmental collapse. J. Youth Stud. *15*, 17–32. https://doi.org/10.1080/13676261.2011.618490.
16. Hicks, D., and Holden, C. (2007). Remembering the future: What do children think? Environ. Educ. Res. *13*, 501–512.
17. Zummo, L., Gargroetzi, E., and Garcia, A. (2020). Youth voice on climate change: using factor analysis to understand the intersection of science, politics, and emotion. Environ. Educ. Res. *26*, 1207–1226. https://doi.org/10.1080/13504622.2020.1771288.
18. Karsgaard, C., and Davidson, D. (2023). Must we wait for youth to speak out before we listen? International youth perspectives and climate change education. Educ. Rev. *75*, 74–92. https://doi.org/10.1080/00131911.2021.1905611.
19. Ojeda, C., and Hatemi, P.K. (2015). Accounting for the Child in the Transmission of Party Identification. Am. Socio. Rev. *80*, 1150–1174. https://doi.org/10.1177/0003122415606101.
20. Norgaard, K. (2011). Living in Denial: Climate Change, Emotions, and Everyday Life (MIT Press).
21. Jones, C.A., Davison, A.G., and Lucas, C.H. (2023). Innocent heroes or self-absorbed alarmists? A thematic review of variety and effects of storylines about young people in climate discourse. WIREs Climate Change. https://doi.org/10.1002/wcc.853wires.wiley.com/climatechange.
22. Klein, N. (2014). This Changes Everything (Allen Lane).
23. Cutter-Mackenzie, A., and Rousell, D. (2019). Education for what? Shaping the field of climate change education with children and young people as co-researchers. Child Geogr. *17*, 90–104. https://doi.org/10.1080/14733285.2018.1467556.
24. Bowman, B., and Germaine, C. (2022). Sustaining the old world, or imagining a new one? The transformative literacies of the climate strikes. Aust. J. Environ. Educ. *38*, 70–84. https://doi.org/10.1017/aee.2022.3.
25. Vamvalis, M. (2023). "We're fighting for our lives": Centering affective, collective and systemic approaches to climate justice education as a youth mental health imperative. Res. Educ. *117*, 88–112. https://doi.org/10.1177/00345237231160090.
26. Teach the Future (2021). Teaching the Future - Summary Report.
27. O'Brien, K., Selboe, E., and Hayward, B.M. (2018). Exploring Youth Activism on Climate Change : Dutiful , Disruptive , and Dangerous Dissent. Jstor, *23*.
28. Carrington, D. (2019). School Climate Strikes: 1.4 Million People Took Part, Say Campaigners (The Guardian).
29. Mayes, E., and Holdsworth, R. (2020). Learning from contemporary student activism: towards a curriculum of fervent concern and critical hope. Curric. Perspect. *40*, 99–103. https://doi.org/10.1007/s41297-019-00094-0.
30. Wahren, J. (2021). Youth Activism and Climate Change in Latin America : Indigenous and Peasant Youth in Defence of Their Human Rights and Territories. Global Campus of Human Rights Policy Briefs. https://doi.org/10.25330/1226.
31. Daly, A. (2022). Climate Competence: Youth Climate Activism and Its Impact on International Human Rights Law. Hum. Right Law Rev. *22*, 1–24. https://doi.org/10.1093/hrlr/ngac011.
32. de Moor, J., De Vydt, M., Uba, K., and Wahlström, M. (2021). New kids on the block: taking stock of the recent cycle of climate activism. Soc. Mov. Stud. *20*, 619–625. https://doi.org/10.1080/14742837.2020.1836617.
33. Davies, A.R., and Hügel, S. (2021). Just adapt: Engaging disadvantaged young people in planning for climate adaptation. PaG. *9*, 100–111. https://doi.org/10.17645/pag.v9i2.3892.
34. Beasy, K., Jones, C., Kelly, R., Lucas, C., Mocatta, G., Pecl, G., and Yildiz, D. (2023). The burden of bad news: Educators' experiences of navigating

climate change education. Environ. Educ. Res. *29*, 1678–1691. https://doi.org/10.1080/13504622.2023.2238136.

35. Beasy, K., Lucas, C., Mocatta, G., Pecl, G., and Kelly, R. (2022). How well does the new Australian Curriculum prepare young people for climate change. The Conversation.
36. Rousell, D., and Cutter-Mackenzie-Knowles, A. (2020). A systematic review of climate change education: giving children and young people a 'voice' and a 'hand' in redressing climate change. Child Geogr. *18*, 191–208. https://doi.org/10.1080/14733285.2019.1614532.
37. Dunlop, L., Atkinson, L., Stubbs, J.E., and Diepen, M.T.v. (2021). The role of schools and teachers in nurturing and responding to climate crisis activism. Child Geogr. *19*, 291–299. https://doi.org/10.1080/14733285.2020.1828827.
38. Chiw, A., Ling, H.S., Aniere, C.L., and O'Sullivan, W. (2019). Young People of Australia and Climate Change: Perceptions and Concerns - A Brief Report, pp. 23–24.
39. Murunga, M., Pecl, G.T., Ogier, E.M., Leith, P., Macleod, C., Kelly, R., Corney, S., van Putten, I.E., Mossop, D., Cullen-Knox, C., et al. (2022). More than just information: what does the public want to know about climate change? Ecol. Soc. *27*, art14. https://doi.org/10.5751/es-13147-270214.
40. Abate, R. (2020). Climate Change and the Voiceless: Protecting Future Generations, Wildlife and Natural Resources (Cambridge University Press).
41. UNESCO (2016). GEM Report: Education for People and Planet.
42. Kelly, R., Beasy, K., Lucas, C.H., Mocatta, G., and Pecl, G.T. (2AD). Answering children's questions on climate change: Curious Climate Schools. In Education and the UN Sustainable Development Goals: Praxis Within and Beyond the Classroom, K. Beasy, C. Smith, and J. Watson, eds. (Springer).
43. Braun, V., and Clarke, V. (2006). Using thematic analysis in psychology. Qual. Res. Psychol. *3*, 77–101.