



Designing learning environments for promoting young people's constructive coping with climate change

Abigail Brown^{a,*}, Silvia Collado^b, Gary W. Evans^{a,c}, and Janet E. Loebach^a

^aDepartment of Human Centered Design, Cornell University, Ithaca, NY, USA

^bDepartment of Psychology and Sociology, Universidad de Zaragoza, Teruel, Spain

^cDepartment of Psychology, Cornell University, Ithaca, NY, USA

*Corresponding author. e-mail address: ahb99@cornell.edu

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Abstract

This chapter first summarizes how the consequences of global climate change (GCC) can harm young people's well-being through physical health impacts and awareness of GCC. We then outline how youth may cope with GCC by denying the problem, distancing themselves from it, or taking individual actions. However, the coping strategy shown to have the best mental well-being outcomes relates to collective actions and agency. Next, an examination of school-based GCC interventions reveals that engaging, participatory approaches may be more effective in promoting positive outcomes for youth and climate action. Our main contribution is a discussion of how

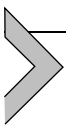
the evidence-based design of learning environments presents an undeveloped but potentially effective way to enhance interventions for the development of constructive GCC coping strategies among youth. Utilizing environmental affordances and design as scaffolding can guide the design of learning environments that give youth opportunities for active cognitive, emotional, and physical engagement with climate change education. Natural environments may be particularly effective in supporting active engagement and pathways to constructive coping. More research is needed to understand what design features underly these pathways to improved well-being and GCC coping strategies that may have positive implications for youth climate action.

Global climate change (GCC) is widely acknowledged as one of the most pressing issues of our time (IPCC, 2022). In fact, GCC has been described as the defining public health crisis in the 21st century (Ma, Moore, & Cleary, 2022). There is increasing awareness of the detrimental effects that human behavior has on natural environments (Cook et al., 2013). This harmful behavior compromises environmental quality and ultimately endangers people's health. The concentration of harmful, polluting substances in the atmosphere has increased significantly in recent years (Fuller et al., 2022) resulting in the greenhouse effect and consequent changes in the Earth's weather patterns including extreme weather events like heat waves, heavy snowfall, floods, tornadoes, hurricanes, droughts, and forest fires (IPCC, 2022). GCC and affiliated phenomena directly and indirectly precipitate physical and psychological problems in human beings (Evans, 2019). Physical health is threatened by high temperatures, the inhalation of common polluting particles, and the greater spread of diseases that previously occurred in a more localized way, such as dengue fever or malaria (IPCC, 2022). This is compounded by the social impact derived from forced migrations and conflicts linked to GCC (Gifford, Sussman, & Gifford, 2014b; Watts et al., 2019).

Children and adolescents are particularly vulnerable to GCC and its consequences (Bartlett, 2008; Watts et al., 2019), but the study of how GCC affects young people is still a relatively nascent field (Chalupka, Anderko, & Pennea, 2020; Ma et al., 2022; Ojala, Cunsolo, Ogunbode, & Middleton, 2021; Sanson, Van Hoorn, & Burke, 2019). Considering the severe impacts of GCC on young populations' health and well-being, we advocate for the need to design the contexts in which youth develop to better support them in a changing climate. To date, most discussion about interventions to address GCC impacts on children and youth has emphasized knowledge acquisition and, to a lesser extent, affective reactions to GCC.

Conversations around this topic are largely bereft of the role that physical contexts may play in supporting the ability of youth to cope with a changing climate. The main goal of this chapter is to explore the ways in which we might be able to leverage evidence-based design to provide contexts for youth development that can facilitate building constructive GCC coping skills. We focus on learning environments, like schools, because they are an important part of youth development, especially the development of resilience and disaster recovery (Masten, 2015). Quality education is a sustainable development goal and can help broaden the potentially positive impacts of well-designed contexts by reaching more youth, but school strikes for GCC demonstrate that youth themselves see their education as insufficient in preparing them for an uncertain future (Verlie & Flynn, 2022; White, Ferguson, Smith, & Carre, 2022). The discussion around youth development and well-being in a changing climate has not yet addressed the role that the design of learning environments can play in maximizing positive developmental outcomes like greater well-being and increased mitigative action against GCC through constructive coping strategies.

The chapter is organized into four main sections. In the first one, we briefly summarize how various aspects of GCC may influence young people with attention to mental health and well-being. Second, we outline various ways in which youth cope with GCC and their implications for well-being and mitigative climate action. We then look at school-based interventions for GCC in terms of both what they typically encompass and pedagogical approaches that may be more effective than conventional ones. Ultimately, we provide a rationale and model to demonstrate how evidence-based design of learning contexts can support youth in developing and sustaining effective coping strategies related to GCC. We also speculate on possible mechanisms underlying these improved GCC coping strategies that may have positive implications for youth engagement with mitigative and adaptive climate action. This discussion brings consideration of physical environment features into awareness as we look for ways to support youth in a changing climate.



1. How GCC impacts young people

GCC and its consequences present serious threats to children and adolescents' health and well-being. Physical health vulnerabilities, such as

increased infections and illness brought on by higher temperatures, pollution, and climate migration, can impact not only long-term developmental and academic outcomes (Bartlett, 2008; Burke, Sanson, & Van Hoorn, 2018; Clemens, von Hirschhausen, & Fegert, 2020; Vergunst & Berry, 2022), but also worsen mental health (e.g., increased depressive symptomatology and negative affect) (Vergunst & Berry, 2022). Mental health can also be lower among youth that are aware of GCC and its consequences (Clayton, 2020; Clemens et al., 2020; Ojala, 2013). These negative impacts are disproportionately worse among groups experiencing poverty and disadvantage (Chalupka et al., 2020). The demands that GCC and its consequences place on young people are extraordinary and, when those demands exceed their ability to adapt, it can result in significant stressors and lower well-being (Lawton & Nahemow, 1979). An illustration of the impacts of GCC on youth's health and well-being, and the variables that might regulate the strength of these impacts, can be seen in Fig. 1. We describe each of these elements below.

The consequences of GCC on mental health are less obvious than the physical ones and are often overlooked in research (Hayes & Poland, 2018). However, growing scientific evidence supports the relationship between the climate crisis and mental health, both directly through GCC impacts and due to worse physical health outcomes (Clayton, 2020; Evans, 2019).

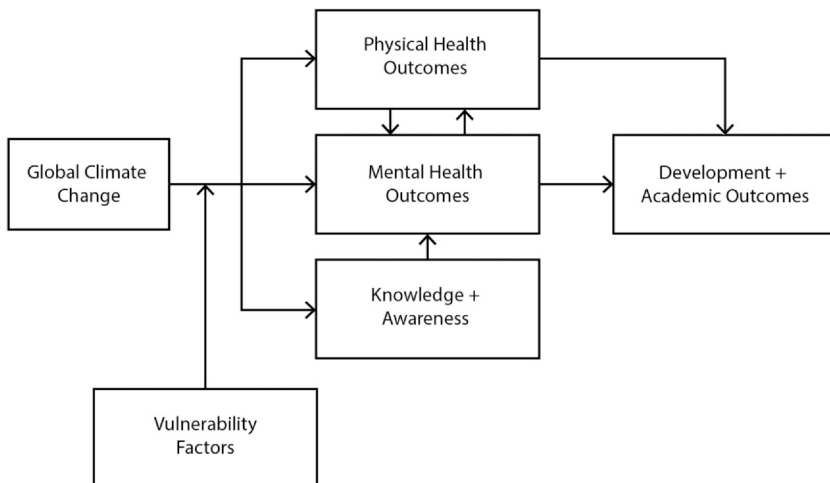


Fig. 1 GCC impacts on youth. *Note:* This figure depicts the impacts of GCC on youth's health and well-being, and the variables that might regulate the strength of these impacts.

Children's mental health outcomes in the context of GCC is emerging as an area of research (Leger-Goodes et al., 2022; Vergunst & Berry, 2022). Young people are especially susceptible to mental health effects due to their stronger emotional reactions to direct impacts of GCC and greater vulnerability to GCC's physical health implications (Burke et al., 2018; Coffey, Bhullar, Durkin, Islam, & Usher, 2021).

1.1 Direct GCC impacts and mental health

Scientists have shown that severe storms associated with rising global temperatures are associated with elevated levels of post-traumatic stress, depression, eco-anxiety, and substance abuse (Bourque & Cunsolo Willox, 2014). Children and adolescents can experience posttraumatic stress disorder (PTSD), depression, anxiety, and a variety of phobias in response to climate disasters (Burke et al., 2018; Clemens et al., 2020; Evans, 2019). In a survey of 10,000 youth across ten countries, 84% of respondents were moderately to extremely worried about GCC and nearly 50% of respondents reported that those feelings impacted their day-to-day lives negatively. Worry about GCC and its impact on daily functioning was stronger for youth living in the most vulnerable countries, such as the Philippines, India, and Brazil (Hickman et al., 2021).

1.2 Physical health GCC impacts and mental health

Physical and mental health are intricately related to one another. Natural disasters and higher temperatures affiliated with GCC also have immediate implications for food insecurity, involuntary migration, and increased pollution (Clayton, 2020; Clemens et al., 2020). Children bear the most severe effects of these adverse phenomena because they are experienced in critical developmental periods and they can accumulate over time (Evans, 2021; Vergunst & Berry, 2022; Watts et al., 2019). Access to enough quality food, clean air and water, and stable living conditions are crucial aspects of child development (Evans, 2021), and without them, youth may end up with elevated morbidity, compromised neurological development, increased inflammation, and greater disease vulnerability (Clemens et al., 2020). These physical health consequences of GCC pose a threat to children's mental health as well. For example, Zika, West Nile, and Malaria infections are linked to elevated immune activation that is associated with mental health issues among youth (Burke et al., 2018; Clemens et al., 2020). Furthermore, stress responses related to mental health symptomology can intensify children's physical health responses to diseases,

pollution, and other GCC consequences as well as increase the risk of cardiovascular disease later in life (Clemens et al., 2020).

1.3 Awareness of GCC and mental health

Awareness and knowledge of GCC and its consequences have also been related to higher levels of eco-anxiety, hopelessness, anger, grief, and negative affect (Leger-Goodes et al., 2022; Martin, Reilly, Everitt, & Gilliland, 2022; Ojala et al., 2021). Children tend to lack understanding of GCC as a whole system and tend not to focus on solutions or adaptation, which can worsen emotional responses to GCC (Lee & Barnett, 2020; Lee, Gjersoe, O'Neill, & Barnett, 2020; Ratinen, 2021). A recent review showed that young people's knowledge of GCC increases with age but remains incomplete, and several misconceptions persist throughout maturation (Lee et al., 2020). For example, adolescents largely believe individual actions can help mitigate GCC, however, they tend to inaccurately estimate the relative efficacy of certain behaviors (Baldwin, Pickering, & Dale, 2022; Pickering, Schoen, Botta, & Fazio, 2020). For instance, although recycling is one of the least effective mitigative actions, youth frequently cite recycling as an effective action they can take against GCC most frequently (Pickering et al., 2020). More accurate and holistic knowledge of GCC adaptation and mitigation strategies is related to better mental health outcomes and constructive hope (Ratinen & Uusiautti, 2020; Ratinen, 2021). Moreover, analysis of young people's questions about GCC demonstrates curiosity about which solutions are the most effective in mitigating GCC (Lee & Barnett, 2020; Tolppanen & Aksela, 2018). However, youth may also have little trust in the ability of formal schooling practices or content to adequately prepare them for GCC (Baldwin et al., 2022; Ojala, 2015b; Pickering et al., 2020), and that lack of trust is correlated with lower mental well-being (Ojala, 2012).

1.4 Factors affecting the relationship between GCC and youth

Not all children will be affected by GCC in the same way (Chalupka et al., 2020). Individual vulnerability factors include genetic markers, heightened neural activity, and personality traits like neuroticism and anxiety (Ma et al., 2022). Children's vulnerability to GCC is also influenced by the social and contextual factors in their lives (Bartlett, 2008). Parental stress, familial violence, poverty, and lower social support have been shown to worsen the effects of GCC on youth (Ma et al., 2022), and the heat, weather, and pollution consequences of GCC will likely intensify levels of

stress and violence (Evans, 2019). Community violence and a lack of cultural identity can also be vulnerability factors (Ma et al., 2022). GCC can accentuate class and racial health inequities both because of greater exposure to environmental risks in conjunction with fewer household and community resources to buffer the adverse outcomes of GCC (Bartlett, 2008; Chalupka et al., 2020; Clemens et al., 2020; Ma et al., 2022). Across scales from individual to macro-level societal and cultural factors, various vulnerabilities can disproportionately worsen physical and mental health outcomes of GCC among children and youth (Chalupka et al., 2020; Ma et al., 2022).

1.5 Gaps in our understanding of how GCC impacts youth

Despite the accumulated knowledge about the impacts of GCC on children and adolescents' physical and mental health, this area of research is an emerging one. There are gaps in the literature that prevent us from fully understanding the effects that GCC has on youth. For example, developmental research on GCC to date has centered on individuals ages ten and older. Far less is known about how children below ten years old respond to GCC (Coffey et al., 2021; Ma et al., 2022). Examinations of cross-cultural variations in how GCC affects youth are also lacking. The research on how GCC impacts youth is still largely confined to economically developed countries rather than those more greatly impacted by GCC but less responsible for its causes (Coffey et al., 2021; Ma et al., 2022; Martin et al., 2022). A few ethnographies have examined how GCC is affecting Indigenous and non-Western populations, but understanding how culture, ethnicity, gender, and age might moderate and exacerbate the effects of GCC is at a nascent stage (Ma et al., 2022; Ojala et al., 2021).

Methodologically, the majority of research on how GCC impacts youth is cross-sectional, so causal interpretations of data are limited, and it is necessary to conduct longitudinal studies for a better understanding of developmental perspectives on GCC (Evans, 2019; Ojala et al., 2021). Methodologies are predominantly quantitative, but the use of complementary qualitative and visual methods such as drawing may be more effective to capture the impact of GCC, particularly in early and middle childhood (Lee et al., 2020).

In addition to examining how GCC impacts youth's health, and the various moderators regulating the effect of GCC on youth, a focus on how families, communities, and societal policies can be prepared to ameliorate GCC's impacts is needed. Children and adolescents, despite particular

vulnerability to GCC, are also resilient. Heuristic shortcuts that treat youth as a homogenous group of passive GCC victims impede opportunities for youth to develop and exercise agency in adapting to and mitigating GCC (Bartlett, 2008). While not forgetting the vulnerable position in which GCC puts youth, researchers need to consider children and adolescents as today's agents of change, who can decide to engage in pro-environmental behaviors (Neas, Ward, & Bowman, 2022; Pickering, Schoen, Botta, & Fazio, 2020) and who can influence others to do the same (Ojala, 2016b; Wallis & Loy, 2021).



2. Youth coping with GCC: implications for well-being and mitigative action

One way that children and adolescents vary when it comes to GCC is how they cope with it, which can influence their well-being. Broadly, coping comes from research on psychological stress, and relates to how people respond to stress (Aldwin, 2007). However, coping with GCC may be distinct from how people cope with most psychological stressors in other contexts (Gifford et al., 2014b). Coping strategies, and their subsequent psychological and social impacts on people and their communities, are influenced by the perception of GCC threats and severity (threat appraisal), then by the perception of what can be done and how effective it will be (coping appraisal), and by the person's general affect and motivation (Reser & Swim, 2011). Each stage of the coping process also depends on individual characteristics (e.g. trait anxiety, former experiences), physical environment characteristics (e.g. symbolic importance/attachment, proximity to threat), and community characteristics (e.g. social capital, norms, culture) (Gifford et al., 2014b; Reser & Swim, 2011).

The psychological stress model of coping with GCC holds true for children and adolescents as well. Ojala and colleagues (Ojala & Bengtsson, 2019; Ojala, 2012, 2013) consider GCC as a stressor for children and adolescents and, as such, GCC can generate negative feelings and diminish well-being and life satisfaction. These authors found that children and adolescents use different coping strategies to deal with GCC, and checked how these coping strategies relate to youth well-being as well as perceptions of various environmental challenges. Young people cope with GCC primarily with emotion-focused, problem-focused, and meaning-focused strategies (Ojala, 2012). The key difference between emotion- (e.g., de-emphasizing the threat

of GCC) and problem-focused (e.g., thinking about what a child can do by themselves about GCC) coping is that the former centers on either denying that there is a problem or distancing oneself from the problem. Problem-focused coping may lead children to engage in pro-environmental behaviors but the enormity of GCC often makes individual actions feel ineffectual (Ojala, 2016a). Emotion- and problem-focused coping can result in pessimism and hopelessness, avoidance of action, and overall lower well-being (Ojala, 2013, 2016b).

Meaning-focused coping is considered the most constructive and conducive to positive outcomes. This coping strategy tends to result in greater hope for the future, more trust in government or social actors, and increased efficacy and agency in terms of making a difference (e.g., having faith in humanity and that we can fix all problems) (Ojala, 2012). Meaning-focused coping can also address both individual and community-level resilience through collective actions while still acknowledging the severity and immediacy of the issue (Ojala, 2016a; Ojala, Cunsolo, Ogunbode, & Middleton, 2021). Ojala (2012) found that meaning-focused coping in youth is positively correlated with optimism about GCC, environmental efficacy, pro-environmental behavior, positive affect, life satisfaction, and purpose in life while also being negatively correlated with negative affect. Constructive means of coping can minimize the harm that awareness of GCC does to young people's mental-emotional well-being while at the same time promoting active engagement in mitigating, pro-environmental behaviors (Ojala, 2016a).

Most coping research adopts an individual or person-based perspective emphasizing the strategies individuals, children, or adults, use to engage with environmental challenges. However, this focus on individual coping strategies given the complexity and magnitude of GCC has serious, inherent limitations for individual well-being, collective well-being, and climate action.



3. School-based GCC interventions for youth climate action

Given the severe impact that GCC has on young people's health and well-being, researchers and advocates encourage the design of interventions to promote mitigative climate action among youth (Busch, Ardoin, Gruehn, & Stevenson, 2019). Climate action is typically defined as

individual pro-environmental behaviors (PEB) such as driving less, using clean energy, and minimizing water use to help mitigate GCC (Gifford et al., 2014b). However, interventions need to go beyond individual PEB because that emphasis is affiliated with problem-focused coping with GCC and lower well-being among youth (Ojala, 2012). Supporting collective actions and meaning-focused coping through interventions can both minimize the harm of GCC and foster young people's well-being.

GCC-related interventions for youth have been largely implemented in traditional educational contexts like schools, and they focus primarily on building knowledge or awareness of GCC through curriculum-oriented climate change education (CCE) (Gifford et al., 2014b; Sanson et al., 2019). Knowledge and awareness of GCC issues, while important, are insufficient to promote climate action (Busch et al., 2019; Gifford et al., 2014b). One reason for this might be that current curricular approaches tend to emphasize building awareness of the negative effects that human actions have on nature, which is associated with negative feelings, such as indignation about insufficient nature protection (Kals, Schumacher, & Montada, 1999) and feelings of guilt (Kaiser, 2006). Negative feelings might increase PEB, but this approach can also provoke the opposite reaction such that individuals feel powerless to adequately protect the environment or impact GCC, or else prompt them to disengage from the issue by labeling the GCC narrative as alarmist (Gardner & Stern, 1996; Gifford, 2011). For instance, children (ages 6–12) can identify energy waste as an immoral behavior in the context of GCC, but also report experiencing negative emotions when talking about the consequences of wasting energy; older children claimed to be disappointed in adults who waste energy and younger ones felt helplessness because of the possibility of completely running out of energy by the time they grow up (Pearce, Hudders, & Van de Sompel, 2020).

Negative emotions derived from GCC lead many young people to protest climate injustice through school strikes (Wallis & Loy, 2021). This is partly because CCE in schools is perceived as insufficient to produce the level of change for which these young activists are advocating (Bright & Eames, 2022; Verlie & Flynn, 2022). These strikes fundamentally present a challenge to the assumptions and values underlying education as it exists today and are a call to reimagine education to better address GCC and prepare young people for climate action (Verlie & Flynn, 2022). Young people also relay that engaging in climate activism through climate strikes allows them to gain life skills such as collaboration, motivation, and

communication, on which they place greater value (White et al., 2022). White et al. (2022) recommend that schools should shift to providing spaces in which youth can be empowered to engage with climate action and deal with uncertainty. In other words, schools should be supporting the development of meaning-focused coping. However, with so many factors influencing GCC appraisal and coping strategies (Reser & Swim, 2011), there can be no one-size-fits-all approach to designing school-based interventions and contexts for the promotion of climate action (Gifford et al., 2014b). More flexible approaches should be considered.

UNESCO's Whole-School Approach represents a flexible framework for supporting climate action, which includes guidelines for how schools can become climate-ready and participate in climate action within their own unique contexts (see Fig. 2) (Gibb, 2016). This model has four action areas including school governance, teaching and learning, community partnerships, and facilities and operations. To meet quality education and climate action as sustainable development goals, UNESCO argued that "schools have a central role to play in helping learners understand the causes of GCC so that they can make informed decisions and take appropriate actions, and in acquiring the necessary values and skills to participate in the transition to more sustainable lifestyles, green economies, and sustainable, climate-resilient societies" (Gibb, 2016, p. 2). Beyond improving the accuracy of children's knowledge about GCC, youth should be actively engaged in implementing climate action. Schools, and learning environments in general, have the potential to better enhance children's climate action not by focusing only on curriculum, but by augmenting knowledge and awareness with ideas and practice for active engagement with the challenges of GCC across levels of scale (Bright & Eames, 2022; Gifford et al., 2014b; Ojala, 2012).

3.1 Novel CCE approaches to teaching and learning

Some researchers advocate for novel pedagogical approaches to CCE as a way of supporting active, meaningful engagement beyond the traditional augmentation of knowledge and awareness (Rousell & Cutter-Mackenzie-Knowles, 2019), but these novel pedagogies are still few and far between because typical education systems emphasize only knowledge and cognitive development instead of creative problem solving (Bentz & O'Brien, 2019). Although knowledge of GCC alone is not enough to spark climate action, new approaches are acknowledging that the impacts of *what* is taught can be influenced by *how* it is taught and how youth engage with learning.

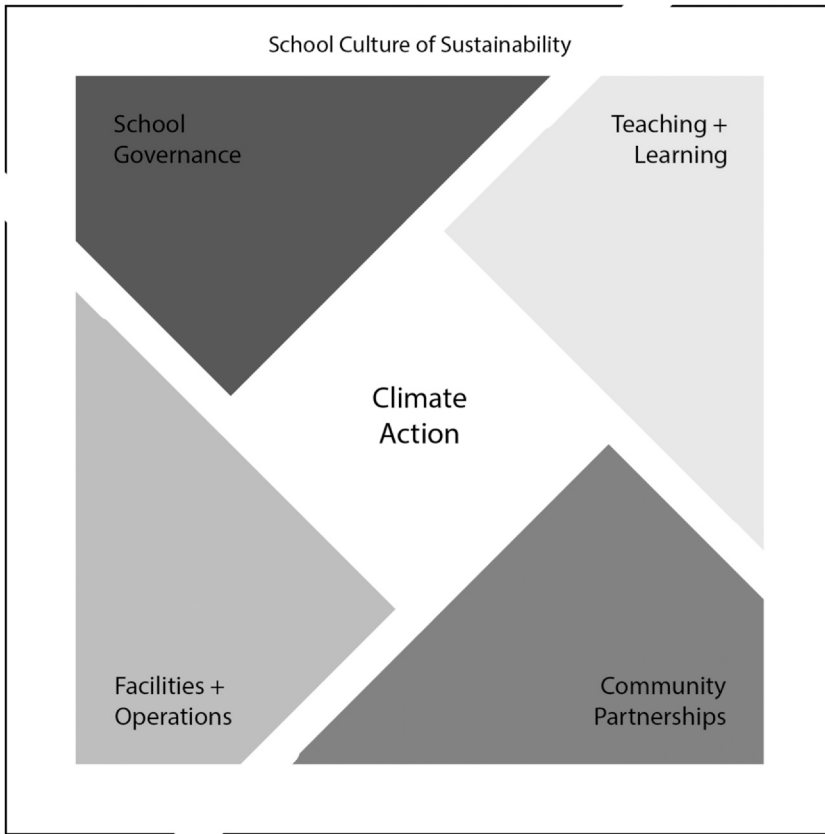


Fig. 2 The whole-school approach to climate action. *Note:* This figure depicts the convergence of school governance, teaching and learning, community partnerships, and facilities and operations within a school culture of sustainability for improving climate action through schools. From Gibb, N. (2016). *Getting climate-ready: A guide for schools on climate action*. UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf0000246740>

Much of this stems from seminal approaches to environmental education like action competence (Jensen & Schnack, 1997). The action competence approach is based on the idea that environmental education should strengthen students' ability to act on environmental concerns. As part of their CCE, students must therefore engage in solutions-oriented activities and have a say in what to do. This engagement requires students to have not just knowledge and insight, but also commitment, vision, and hands-on experiences (Jensen & Schnack, 1997).

Active pedagogical approaches that emphasize the importance of both the process of engaging and the products of engagement with CCE may

indeed be more effective when it comes to increasing young people's climate action through school-based interventions (Allen & Crowley, 2017). However, we would argue that the Whole-School Approach to Climate Action is still incomplete because it lacks focus on the development of constructive coping strategies among youth (Ojala, 2012). As such, interventions for improving meaning-focused coping need to “upskill young people on GCC action in ways that are empowering and meaningful, avoid overwhelming or causing feelings of hopelessness or burnout, [and]... improve the overall emotion regulation and coping efficacy of the young person” (Ma et al., 2022, p. 9). To our knowledge, there is no evidence of whether interventions support constructive coping strategies. CCE initiatives, while enhancing knowledge, may also promote emotion- or problem-focused coping and risk lowering well-being and preventing climate action (Allen & Crowley, 2017; Ojala, 2012; White et al., 2022). Focusing school-based GCC interventions for youth in the context of the learning environment can be a potentially highly effective way to support the development of constructive coping strategies and well-being among youth, so they are more likely to engage in collective climate action.



4. How design of learning environments can influence young people's coping with GCC

A factor that is generally overlooked in research on how to enhance resilience in relation to GCC in youth is the physical context. Little attention has been given to the features and design of the physical settings of interventions helping children navigate GCC. Gibb's (2016) recommendation for educational facilities and operations in the Whole-School Approach to enhance climate change education (CCE) and action is to “make your school a model of climate action” (p. 15). While this nods to the role the physical environment of the school can play in increasing climate action among youth, the recommendations include things like planting trees, turning off the lights, placing proper waste and recycling receptacles around, encouraging people to use sustainable transportation, and replacing paved areas with absorptive surfaces (Gibb, 2016). These guidelines essentially call for the design of green school buildings and encourage individual PEB. However, simply occupying a green school building alone has not been found to encourage pro-environmental behaviors among students (Cole & Hamilton, 2019), and increased

collective action should also be among the aims of CCE. There are ways in which the learning context can be designed and leveraged to increase the chances of youth appraising GCC in ways that lead to the development of constructive GCC coping strategies and greater climate action.

People both shape and are shaped by their physical environments in ways that are more active than the passive facilities and operations recommendations that [Gibb \(2016\)](#) proposes. These human-environment transactions have the potential to transform behavioral and developmental outcomes like greater coping capacity ([Gifford, Sussman, & Gifford, 2014a](#)). Features of the physical environment present cues called affordances that a person may use to support a desired action (e.g. the shape, height, and sturdiness of a chair can afford the opportunity to sit for someone who needs a rest); the opportunity provided by the physical environment may therefore influence a person's subsequent behaviors ([Gibson, 2014](#)). At the same time, how those cues are perceived may lead to different actions depending on a person's individual characteristics, needs, or abilities in the moment (e.g., a person needing a rest may choose to use a chair to sit, but another may use it to set down a heavy box they were carrying). In this way, people shape or utilize their environment to suit their needs and desires ([Withagen, de Poel, Araújo, & Pepping, 2012](#)). Individual competencies and needs are critical components in shaping all interactions between humans and their physical environments, and imbuing these contextual features with both function and meaning ([Heft & Kyttä, 2006](#); [Lawton & Nahemow, 1979](#)).

Children broadly perceive affordances provided by their environments differently from adults and often see a greater range of functions in contextual features than older populations ([Heft, 1988](#)). Considering the variable functional opportunities children's environments can provide them for active engagement and learning, the physical environment "offers a rich way of conceptualizing the ecological resources for human development" ([Heft, 1988](#), p. 29). An affordance-based evaluation of the design of school environments is helpful for drawing attention to the context in which learning occurs, and ways the physical setting can support a range of pedagogical approaches that help youth develop stronger connections within their communities, a greater sense of purpose, and more translatable skills ([Young, Cleveland, & Imms, 2020](#)). These findings echo researchers calling for education reform and more effective CCE in response to school climate strikes ([Bright & Eames, 2022](#); [Verlie & Flynn, 2022](#); [White et al., 2022](#)). Although children tend to have less cognitive capacity to

comprehend GCC and less agency to address its challenges than adults (Lee & Barnett, 2020; Lee et al., 2020), well-designed affordances in learning environments may offer ways to scaffold CCE to promote meaning-focused coping strategies.

Scaffolding refers to processes by which an expert instructor, often an adult, provides support for children's learning, which can boost the child slightly beyond their current skills and helps to elevate their learning and capacity (Wood, Bruner, & Ross, 1976). The instructor is responsive to the child's competencies so they may engage in learning that develops skillsets gradually rather than placing too many demands on youth that could be discouraging (Mermelshtine, 2017). Although this approach is largely studied in the social context between instructor and child, the physical context may also scaffold learning through environment-human transactions (Eshelman & Evans, 2001). Utilizing affordances and action possibilities in learning environments, it is plausible that well-designed learning contexts, supported by scientific evidence, may be able to alleviate excessive GCC demands on youth. This could in turn scaffold CCE to incrementally build children's competencies for climate action by supporting constructive GCC coping strategies (Lawton & Nahemow, 1979). Fig. 3 depicts how when there is a mismatch between the environment and

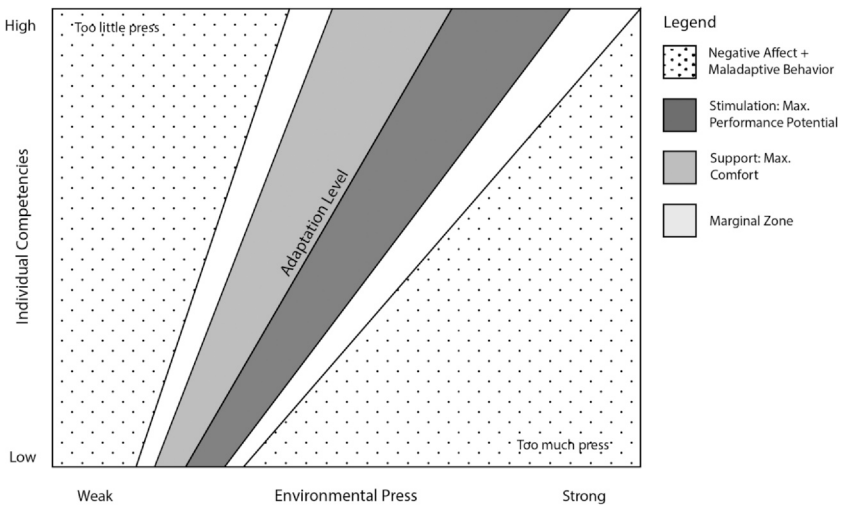


Fig. 3 Lawton's model of environmental fit and press. Note: This figure depicts the relationship between environmental demands (press) and individual competencies.

an individual it can be affiliated with poor outcomes, but where the environment can provide a level of demand slightly above an individual's ideal adaptation level, it can actually improve their outcomes (Aldwin, 2007; Lawton & Nahemow, 1979). It is necessary to understand how and through what mechanisms learning environment design can promote more effective coping strategies for addressing GCC among children and youth, but more research is needed to identify specific features that do so.

4.1 Designing learning environments to support youth in a changing climate

Participatory processes, specifically those related to youth exploration of GCC, can occur within particular settings. For example, Cutter-Mackenzie-Knowles and Rousell (2020) introduce the concept of a “co-researcher playspace” as a learning environment in which children explore the subject of GCC with creative autonomy that helps develop their expression, agency, and contribution (p. 209). Learning environments supporting CCE should focus on providing affordances for active youth participation in receiving *and* generating knowledge on GCC (Allen & Crowley, 2017; Jensen & Schnack, 1997). By doing so, learning environments will most likely enhance meaning-focused coping among youth which in turn promotes positive outcomes like agency, trust, and collective action (Cutter-Mackenzie & Rousell, 2018; Ojala et al., 2021; Sanson et al., 2019; Trott, 2019). This participatory interaction is afforded by a variety of engagement types, tools, and materials in the ‘co-researcher playspace’ (Cutter-Mackenzie-Knowles & Rousell, 2020). Variety is important because that flexibility provides the level of responsiveness and choice necessary to meet and build a diverse range of competencies across youth as they learn to cope with GCC (Cutter-Mackenzie-Knowles & Rousell, 2020; Lawton & Nahemow, 1979; Mermelshtine, 2017). Youth-led inquiry into climate action has positive implications not just for individual agencies, but also for young people's broader community and collective actions (Trott, 2020, 2021).

Just as there can be no one-size-fits-all approach to CCE (Gifford et al., 2014b), there is no prescriptive design that would fit each situation and still allow these ‘co-researcher playspaces’ to function flexibly (Cutter-Mackenzie-Knowles & Rousell, 2020). However, considering the role of the physical environment in supporting participatory processes with flexible engagement opportunities, we can expand on the present conception of ‘co-researcher playspaces’ for constructive GCC coping and climate

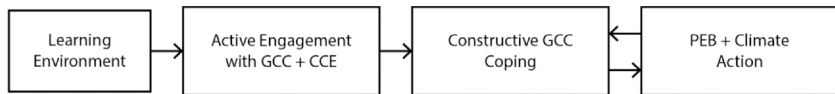


Fig. 4 Pathway from learning environments to constructive coping and GCC action. *Note:* This figure depicts the pathway through which we propose the learning environment may scaffold active, participatory approaches for engaging with CCE. Active youth engagement may result in constructive coping strategies that have positive implications for climate action.

action outcomes among youth. Fig. 4 depicts the pathway through which we propose the learning environment may scaffold active, participatory approaches for engaging with CCE. In turn, active youth engagement may result in constructive coping strategies that have positive implications for climate action. Features of children’s learning environments should reduce GCC harm *and* promote behaviors that are affiliated with constructive coping strategies. Employing the learning context to improve the probability of youth appraising GCC in ways that lead to constructive coping strategies will require attention to affordances that leverage their motivations for engaging with climate action (i.e., curiosity/clarity through pedagogies of action competence) (Reser & Swim, 2011). We can also design for experiences afforded by the physical environment that address (1) individual characteristics (e.g. prior experiences dealing with threats, improved resilience, optimism), (2) community characteristics (e.g. increased collective efficacy and agency, social capital/networks), and (3) perception of the physical environment (e.g. place attachment) (Reser & Swim, 2011).

We must design learning environment affordances for various types of engagement, including, but not limited to, thinking, feeling, and doing (Bright & Eames, 2022; Rousell & Cutter-Mackenzie-Knowles, 2019). These learning environment affordances must also be designed at various scales including attention to learning aids and classroom technology, the classroom, the school, and the school’s context as it is embedded in a community (Ceschin & Gaziulusoy, 2016). Here we offer some preliminary ideas for linking current research and theorizing of developmental aspects of coping with GCC to the design of learning environments and instructional aids. Table 1 provides one example of a design feature at each scale that could ultimately support a type of engagement for the development of constructive GCC coping. The rationales for those examples, and others, are explored next.

Table 1 Examples of learning environment features for supporting GCC coping.

Design goal	Products/ learning aids	School/ classroom	Beyond the school
Active Cognitive Engagement (Think)	Loose parts + open-ended objects	Hallways + public gathering spaces	Interactive technologies
Active Emotional Engagement (Feel)	Movement and music-making objects	Therapeutic natural spaces	Murals in the community
Active Physical Engagement (Do)	Data measuring toolkits	School gardens	Proximity to conservation areas

Note: This table presents a matrix linking various types of active engagement to various scales of design.

4.1.1 Thinking: affordances for cognitive engagement

For active cognitive engagement with CCE, the learning context should help facilitate discussion, social interaction, and attentiveness, because these are affiliated with collective efficacy and generally motivating climate action among youth (Busch et al., 2019; Monroe, Plate, Oxarart, Bowers, & Chaves, 2019). Deliberative discussions, particularly with climate scientists, that can address misconceptions about GCC are an important part of effective CCE (Monroe et al., 2019). Discussions that relate accurate scientific climate knowledge to how youth can make a difference can also improve hope and motivation (Chawla, 2020b). At the classroom level, flexible furniture and the ability to rearrange it can afford discussion and youth-led pedagogies. It may also be pertinent to incorporate interactive technologies that allow schools to bring in climate scientists from around the world for virtual discussion. Reflexive or critical discussions, such as those that attend to indigenous cultural and historical relationships to the environment, can be affiliated with deeper knowledge of GCC and a better understanding of resilience (Mbah, Ajaps, & Molthan-Hill, 2021; Schweizer, Davis, & Thompson, 2013). Culturally-informed discussions may be enhanced in learning contexts that utilize localized building methods, called vernacular architecture, that are more responsive to the area and demonstrate how it is possible to live in congruence with the environment.

The promotion of climate action and PEB can also be achieved through the development of social networks, strong social norms, and social trust (Busch et al., 2019; Chawla, 2020b; Collado, Staats, & Sancho, 2017). For

example, participation in school strikes appears to be driven by perceived activism in the peer group, and intergroup identification with others involved in climate protection coupled with personal environmental norms (Sabherwal et al., 2021; Wallis & Loy, 2021). The feelings of collective efficacy (the belief that together we can take significant action to stop GCC) derived from these movements help reduce the frustration and hopelessness typical when dealing with GCC (Ojala, 2012). In schools, hallways and other liminal spaces that contain public gathering areas tend to afford high amounts of social interaction (Pasalar, Knapp, Noschis, & Pasalar, 2007). Then, further affordances for collective action and collaboration can help build social trust and networks (Chawla, 2020b). Virtually, social networks have been built through climate-focused social media communities that have positive implications for collective resilience and participatory design processes (Simpson, Napawan, & Snyder, 2019). Responsive settings and loose parts toys provide children with more open-ended physical interactions that are often acted upon collectively to produce active learning and social interaction (Gençer & Avcı, 2017; Nicholson, 1972). Natural environments in particular have features that afford open-ended play and cooperation among youth (Gençer & Avcı, 2017), which has been linked to higher levels of learning, resilience, and PEB (Kuo, Barnes, & Jordan, 2019).

Providing environments in which youth interact with nature also has positive implications for active cognitive engagement because nature can increase attentiveness (Kaplan & Kaplan, 1989). Nature exposure may also be associated with improved cognitive development (Dadvand et al., 2015). Time spent in nature has been associated with higher levels of critical thinking, empowerment, efficacy, place attachment, agency, communication, and hope (Bowers, Larson, & Parry, 2021; Pereira & Freire, 2021). Adding green spaces and views of nature in classrooms, schools, and along transportation routes to schools will likely support the attention and cognitive development necessary for active cognitive engagement. Within the school, this could look like designing a central courtyard, building a garden area, and even adding nature imagery and materials to interiors to stimulate the senses and the brain.

4.1.2 Feeling: affordances for emotional engagement

Environmental issues can evoke strong emotions among youth (Ojala, 2015a). Tapping into those emotions mindfully and having supportive spaces in which to share those emotions is important for CCE and climate

action (Chawla, 2020b). Features of the learning environment related to creative expression and nature connection can support emotional engagement and the development of positive emotions affiliated with constructive GCC coping. Arts-based transformative learning can increase young people's mindfulness towards GCC *and* a sense of empowerment. Creative expression through art engages children's imagination, allows them to empathize, embraces the complexity and uncertainty of wicked problems, enables alternative forms of protest, and can even translate into direct action (Bentz & O'Brien, 2019). The participatory process of co-designing artwork for public spaces has been shown to have a positive impact on youth emotional engagement with GCC which demonstrates the benefits of creative collective visioning through artwork (Sitas et al., 2022). Learning environments should be intentionally designed to have walls or objects on which students can design and implement murals, messages, and other marks as an expression of hope and collective action. Galleries and exhibit cases that can be curated by youth may also afford those types of interactions.

Other forms of creative expression, such as music and bodily movement, also have positive implications for young people's development of mindfulness, connection to others, and overall resilience (Nijs & Nicolaou, 2021). Nijs and Nicolaou (2021) provide examples of music and movement activities to those ends such as going for 'soundwalks' outside, listening and moving to music each child brings from their culture, or creating and imitating characters inspired by music. These types of activities can be supported by providing enough space for movement, designing meandering paths through spaces, attending to acoustics in spaces, and having props that align with variable movements or create music and rhythm (e.g., ribbons, scarves, musical instruments). Movement and other physical activity also enhance cognitive development and engagement (Doherty & Miravalles, 2019).

Just as with cognitive engagement, a key factor in the promotion of a positive emotional response to GCC is contact with nature. If youth are to act to mitigate the negative consequences of GCC, it is essential that they appreciate the natural environments they will ultimately help to preserve (Chawla, 2020a). People have a basic need and propensity to connect with the natural world, often referred to as biophilia (Kellert, 2002; Wilson, 1986). Biophilia can manifest in feelings of connection to nature, which involves an emotional attachment to nature (Chawla, 2020a; Green, 2018) and a dispositional tendency to empathize with the natural world (Tam et al., 2013). Hoffman (2001) argues

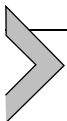
that the capacity to empathize with other creatures predisposes individuals to care for others. Similarly, connectedness with nature and place attachment often lead to PEB in adults and children (Chawla, Derr, & Clayton, 2012; Ives et al., 2018; Schweizer et al., 2013). Walking meditations in natural environments, like the ‘soundwalks’ mentioned above, and adventure therapy or education in nature fulfill the double function of improving youth well-being through emotional engagement and, in turn, increasing PEB (Barrable, Booth, Adams, & Beauchamp, 2021; Mansfield, Cotton, & Ginns, 2020; Rosa, Larson, Collado, & Profice, 2021). Providing natural spaces using design recommendations for therapeutic outdoor environments and trauma-informed approaches is likely relevant for supporting active emotional engagement and biophilic nature connection in learning environments (Camponeschi, 2022; Tamblyn et al., 2022; Whitehouse et al., 2001). In children’s hospital gardens, for example, Whitehouse et al. (2001), recommend incorporating features with running water, giving the space a sense of enclosure (e.g., with trees, tall grasses, or shrubs), and having plants and artwork that stimulate multiple senses (e.g., lavender flowers, edible plants, and labels for them).

4.1.3 Doing: affordances for physical engagement

Positively charged emotions in youth can also encompass pride for *doing* what is considered right for the environment, or even pride when observing others take climate action (Krettenauer, 2017), and these positive emotions can lead to PEB (Matsuba, Krettenauer, Pratt, & Jensen, 2020). Therefore, the learning context can support physical engagement by providing opportunities for youth to do something about GCC, or ways to develop skills for constructive coping and collective action in CCE. Helping youth develop a sense of agency, efficacy, and hope is important for school-based GCC interventions (Chawla, 2020b; Ojala et al., 2021). This can be done by having youth implement projects in their school and community with a real impact (Monroe et al., 2019) and, again, especially through interaction with natural environments. Place-based education means to derive learning from the local community and environment (Schweizer et al., 2013; Sobel, 2013). This type of pedagogy allows youth to engage in learning and projects that have authenticity in potential risks and outcomes, which is critical to the development of constructive GCC coping skills like efficacy (Mansfield et al., 2020). It is not enough to just know the environment, it is also necessary for youth to be aware of the real consequences of their actions for the environment (Collado & Evans, 2019).

Making the positive consequences of children's actions more tangible by physically doing something will increase a sense of efficacy and a sense of the possibilities to minimize GCC (Khadka, Li, Stanis, & Morgan, 2020). Environments that afford risk-taking in authentic situations should scaffold the difficulty so competencies can be built incrementally by balancing more physically engaging contexts with restorative environments that enhance cognitive and emotional engagement.

Place-based education in natural environments specifically can reinforce constructive GCC coping strategies among youth since direct contact with nature enhances the development of ecological awareness and stewardship behaviors (Collado, & Evans, *In Press*). Connection to nature is posited to overlap with constructive hope and climate action through experiences that model care for nature, help youth gain confidence in nature, and demonstrate collective actions that help nature (Chawla, 2020a, 2020b). For instance, children participating in a school-based stewardship project that allowed them to help with local salamander conservation gave youth a high level of responsibility and increased their efficacy in conservation behaviors (Barthel, Belton, Raymond, & Giusti, 2018). Barthel et al. (2018) also showed how this physical engagement intersects with emotional engagement because of how youth came to empathize with the species. Another program for youth in Colorado that had them record climate data attributed its success in CCE to both the place-based engagement and how that fostered youth discussions with local scientists in the field context (Hallar, McCubbin, & Wright, 2011). Intersecting place-based education with open dialog between youth and scientists demonstrates the synergies between physical engagement and cognitive engagement. Natural areas with biodiversity that afford active engagement in conservation areas should be designed into or in close proximity to schools. Incorporating school gardens can be another way to engage youth in CCE to develop their agency (Lofstrom, Klockner, & Nesvold, 2020).



5. Conclusion

Evidence-based design can support the implementation of novel CCE approaches to help scaffold constructive coping for long-term climate action and behavior change. However, more research is needed to understand how effective those approaches are and to discover the underlying cognitive and socioemotional processes that explain how they function. The ideas provided

here on design features to enhance young people's coping strategies with GCC through the learning environment context are preliminary. Mixed-methods studies with a comparison of young people's GCC coping before and after engaging with different types of environments can help identify more features, how they are used, and how effective they are. Analyses should also examine the possible synergies of features that afford more than one type of engagement, which could demonstrate the powerful potential of design to support constructive GCC coping among youth. It will also be necessary to uplift young people's voices in researching and developing design guidelines because participatory processes can foster constructive coping outcomes (Jaffe & Loebach, 2023). When children imagine their own ideal environmental school, their drawings illuminate many of the same themes explored in this chapter including positive emotional engagement and nature connection (Gal & Gan, 2021).

Although there are many gaps in understanding how children and adolescents are impacted by GCC, and the strategies that they use to cope with it, the contexts in which children and youth learn about and cope with GCC offer a promising and largely undeveloped area for interventions. Evidence shows that avoidance coping strategies tend to develop in childhood and adolescence and this leads to inaction against climate change. Instead, action-oriented, constructive coping strategies should be promoted. This can be done through the evidence-based design of learning environments that provide affordances for cognitive, emotional, and physical engagement. Nature-based learning may be particularly effective for increasing climate action through children's constructive coping strategies and well-being because interactions with the natural environment engage young people's cognitive, emotional, and physical capabilities (Baird et al., 2022; Chawla, 2022; Moll, Collado, Staats, & Corraliza, 2022) without worsening mental health and well-being (Curl, Stanley, Brown, & O'Brien, 2022). Experiences in nature during childhood leave a mark on children's PEB that lasts into adulthood (Evans, Otto, & Kaiser, 2018). A climate-resilient planet is inherently tied to climate-resilient people who are willing to act, and this necessitates consideration of how the environments in which youth develop can enhance their well-being in the face of a changing climate.

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