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**Meet Me in the Middle: A Scoping Review on Understanding Adolescent Needs in Climate
Communication**

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MPH 683: ILEX

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August 12th, 2022

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Acronyms

Action competence in sustainable development	ACiSD
Alliance for Climate Education	ACE
Black, Indigenous, People of Color	BIPOC
Climate Change Education	CCE
Environmental Justice Coalition	EJC
Extended parallel process model	EPPM
Instagram	IG
Inter-generational learning	IGL
Sustainable development	SD
Short Message Service, also known as text messages	SMS
Science, Technology, Engineering, Math	STEM
Transformative Learning Theory	TLT

Note: This paper is part of a series regarding eco-anxiety and climate activism among youth. The following papers are part of the series: Ask Your Doctor About: Prescribing Activism for Eco-Anxiety in Adolescents; Building Sustainable Environmental Activism Programs for Youth; Youth Climate Change Activism: How Activism in Youth can be Encouraged to Help Combat Climate Change and Reduce Youth Health Impacts; Utilizing the Power of Youth for Climate Action: Implications for Health Professionals; Meet Me in the Middle: A Scoping Review on Understanding Adolescent Needs in Climate Communication. These papers were written to meet USF MPH Behavioral Health program CEPH Foundational Competencies (Appendix B).

Abstract

The greatest effects of climate change are likely to be felt by youth. Young people are disproportionately affected by climate change due to their critical developmental stage and lack of power, and they experience both higher severity and prevalence of mental health issues related to climate change. Strong emotions have long been recognized as potential catalysts for action, or they may lead to paralyzing feelings of being overwhelmed. Climate communication is a critical tool to spark climate concern and encourage action. Activism, in turn, may help youth manage their anxiety about climate change. This scoping review examines emerging evidence on communicating climate change issues with adolescents and identifying key characteristics or factors for success, particularly to facilitate climate action, and provides best practices to support adolescents to communicate their own messages on climate change as a potentially important avenue to engage youth action. The review includes peer-reviewed articles and gray literature focused on contextualizing adolescent development, best practices to work with youth/adolescents, and research on climate change education. The distinct social and neurodevelopmental stage of adolescents should be taken into consideration when communicating with youth on climate change and encouraging activism to harness their strengths and minimize their vulnerabilities. Climate change education should go beyond relaying facts and provide opportunities to support youth agency and action to transform perspectives. This review provides a practical synthesis of current information to foster successful climate communication for and by youth, and highlighting additional areas for further research.

Keywords: youth, adolescents, climate change, activism, communication

Meet Me in the Middle: A Scoping Review on Understanding Adolescent Needs in Climate Communication

Climate change is considered one of the most critical issues of our time. Simultaneously, the news is rife with stories on the deteriorating mental health of young people. There is a growing recognition that these two issues may be interrelated. Results of a large-scale global survey of young adults showed 84% were at least moderately worried about climate change (Hickman et al., 2021). On the other hand, strong emotions have long been recognized as potential catalysts for action, or, conversely, to lead to paralyzing feelings of being overwhelmed. Both for the individual mental health of youth and for the health of our planet, it is important that youth feel supported and capable of having an impact in shifting the practices and policies to address this crisis they will inherit. To this end, youth must feel both equipped with the knowledge to understand the problems and the skills to communicate to foster collective action and systemic change. This paper will examine what is known about supporting youth in the arena of climate or environmental activism, and help winnow out actionable steps to improve communication to encourage and support their actions. Two main questions guide this review:

- a. What is known about successful climate communication, particularly to help mobilize action, and how might that need to be tailored to the special developmental, cognitive, and social needs of adolescents?
- b. How can we empower adolescents to be effective climate communicators?

Background and Literature Review

Let's Talk About It: The Importance of Effective Climate Communication with Youth

In climate scientist Katharine Hayhoe's book *Saving Us: A climate scientist's case for hope and healing in a divided world* (2021), she argues that the single most important thing each of us can do to address climate change is to talk about it: "why it matters, and how we fix it

-- and use our voices to advocate for change within our spheres of influence...connecting with one another is how we change ourselves, how we change others, and ultimately, how we change the world. It's contagious." (p.213). However, in our current politicized context, talking about climate change can feel especially challenging. While over 99% of climate scientists agree climate change is caused by humans (Lynas et al., 2021), only 57% of Americans do, and only 35% are talking about it (YPCCC, 2021). Research has found political identity to consistently be a major determinant in perception of climate change, above both personal experience with climate events (Marlon et al., 2021) and scientific literacy (Kahan et al., 2012). Attempts to shift beliefs on climate change in adults have had limited success through initiatives like strategic message framing (Nisbet, 2009) and climate change education (Moser & Dilling, 2007), because perceived threats to the more set socio-ideological identity of adults have made it challenging. Maybe it is time to look beyond adults for change.

The greatest effects of climate change are likely to be felt by youth, as they will inherit the repercussions of the choices made today. And many youth are aware of this unfair burden. Groundswell movements by youth activists have shown the power of youth to mobilize, including international Fridays for Future youth climate protests, with public youth faces like Greta Thunberg, Vanessa Nakate, and others. However, there needs to be even greater collective action to shift the tides of political will for government and private industry to enact the widespread changes necessary to avoid the most catastrophic effects of climate change. Climate change concern is considered a key predictor of both individual and collective action (Hornsey et al., 2016). Climate communication is considered a critical tool to both spark climate concern and encourage action. In this paper, I will examine emerging evidence on communicating climate change issues with adolescents and identify key characteristics or factors for success, particularly to facilitate climate action. A secondary focus for this review is to provide best practices to support adolescents to communicate their own messages on climate change, as a potentially important but lower threshold activity to engage youth action.

As a note, while the term “educator” is used in this paper, the term is not meant to be exclusive to those in formal teaching roles. There is increasing evidence of the importance of informal educational experiences that take place outside the classroom to successful climate change education and engagement (e.g., Rousell & Cutter-Mackenzie-Knowles, 2020; Dou et al., 2019). This term is meant to be inclusive of all those supporting youth awareness on climate change, whether a teacher, a Scout leader, a park ranger, a museum docent, or just a caring adult acting in a mentoring capacity.

1. Adolescents: More Than (Sometimes Giant) Mini Adults

Adolescents are no longer children, but neither are they fully adult, with both unique strengths and vulnerabilities that fade as they enter adulthood. Adolescents are defined by the World Health Organization (WHO) as people between the ages of 10 and 19 (2022), although neurologists suggest some of these changes may still be occurring into the mid-20s.

Adolescence is a special developmental period in that youth experience the greatest physical, mental, and social growth and change since infancy (Naar & Suarez, 2021; Jensen & Nutt, 2016). This marks adolescence as a key stage for intervention to help them view climate change as important and something they can and should take action to address. Three areas where communication around climate issues may be particularly unique and important for adolescents are: identity development, educating others, and techniques to minimize negative mental health effects related to climate concerns.

1.1 Identity: How to Grow a Climate Activist

Talking about climate change offers an important opportunity to not only formulate one's own thoughts and beliefs but also to help convey aspects of one's identity to others. Identity development is considered the central developmental task of adolescence (Erikson, 1968). Communication is a critical part of negotiating identity, with adolescence noted as a period of particular openness to diverse beliefs and behaviors as they work to decide on their own (Schwartz et al., 2011). An adolescent's socio-political ideology may still be fluid, and is less

likely to interfere with their learning about climate change (Lawson et al., 2019). Further, studies suggest early adolescence (10-14 year olds) is when civic involvement is developed (Smetana et al., 2006, as cited by Sass et al., 2022), so this may be a particularly critical window to engage adolescents' understanding and interest in climate change issues. Role exploration is a key contributor to identity formation (Erikson, 1968; Duell & Steinberg, 2021), so opportunities for adolescents to try different roles in activism should be encouraged.

Identity can transcend specific situations, and, once set, tends to be rather stable, providing a broader base on which individual choices are made. Self-identifying as pro-environment has been shown to be an important predictor of overall "green" behavior that extends beyond a single action or class of actions, like recycling or using mass transit (Gatersleben et al., 2014). Perception of individual identity can have a significant impact on goal setting, behavior, and future career choice (Dou et al., 2019). Communication around science as a young child was shown to have a significant positive influence on students' "STEM identity." In a study in college students, the strongest predictor of STEM identity was talking with family or friends about science as a young child and, to a lesser extent, consuming fiction and nonfiction science media (books and television), even after controlling for home support, gender, and parental education (Dou et al., 2019). Early informal (non-school setting) science experiences may have a larger than expected role in forming a science identity (Dou et al., 2019), so programs in those settings should be encouraged, particularly those programs that will facilitate peer or family conversations around climate change. However, identity as a climate activist should not be limited to those youth that excel in science. Students with strengths in areas outside of science should also be supported to find an identity as a climate activist, as the value of effective communication (writers, poets) and artistic expression (artists, graphic design, video) may reach where trying to convey science facts has failed in shifting beliefs and actions.

1.2 Education: Share the Wealth

Adolescents may have a uniquely effective window for educating others on climate change, particularly their parents and other caring adults and fellow adolescents.

Studies have shown intergenerational learning (IGL) may have promise in shifting the knowledge, attitudes, and behaviors related to climate change in older generations (Lawson et al., 2018). The high level of parental trust in their child is theorized to make them more willing to listen to or accept their child's views on complex topics (Lawson et al., 2019). A study of North Carolina middle schoolers (aged 10-14 years) taught with a school-based curriculum that focused on local climate effects and included an adolescent-conducted parent interview about weather change resulted in significant gains in both child and parent concern levels on climate change, with the largest effect seen in conservative father-daughter dyads (Lawson et al., 2019). This is particularly significant because conservative males have consistently had the highest skepticism and lowest concerns around climate change (McCright & Dunlap, 2011). Empowering adolescent girls to be effective climate communicators may serve the dual role of not only helping to build climate change concern in the adults around them, but may also serve to combat gender stereotypes that discourage girls from speaking up about their science knowledge (Lawson et al., 2019). Alliance for Climate Education (ACE, 2017), a youth and climate civic engagement program, conducted an assessment of a scalable SMS and short video training (4 minutes) to encourage youth to talk about climate change. The youth were encouraged to have one-on-one conversations with family members on climate change using a motivational interviewing framework. Results from a small sample of parent interviews indicate the quality of the conversation was more important than the informational content, while for youth the most transformative aspect seemed to be "breaking the ice" on speaking up about their beliefs (ACE, 2017). They determined SMS could be an effective method of engaging youth to take in-person action, and that encouraging youth to have a conversation on climate with a family member or friend can be a helpful first step (ACE, 2017).

Peer relationships take an outsized significance during adolescence, which may be another valuable way to leverage adolescent climate communication. Adolescents are particularly prone to turn to peers for support and social modeling (Smetana et al., 2006), so supporting early adolescents in effective climate communication may be particularly valuable for activating fellow peers. The successful effects of this can be seen in the widespread, global participation in the Fridays for Future youth movement, which resulted in weeks of consistent protests and opportunities for youth to speak in front of the UN Climate Change Conference and other international meetings (Kowasch et al., 2021).

The development of educational exhibitions or materials by students, whether for adults or peers, have shown to contribute to transformational learning in the students, as well as provide educational gains for the observers. Transformational learning, discussed in more detail later, is defined as a perspective transformation, where learning leads to critically examining prior interpretations and assumptions to achieve a new meaning (Trott, 2022). This may be the critical key to reaching the broad acceptance of climate change necessary to meet the collective action needs of our current climate crisis. Studies that combined science knowledge and artistic mediums seem to be particularly effective at achieving transformative learning (Bentz, 2020), including projects like students in Portugal developing exhibitions on climate change (Kowasch et al., 2021), public service announcements (PSAs) by U.S. East Coast college students (Rooney-Varga et al., 2014), young adolescent's sharing their photovoice-inspired projects in the U.S. Mountain West (Trott, 2022), and interdisciplinary projects combining art and science students (Jacobson et al., 2016). Art has a long history of both facilitating meaning-making and civic engagement, so the engagement of arts and humanities programs in the climate discourse may be an important lever to help shift the hearts and minds of society on this issue.

1.3 Under Pressure: Protecting Adolescents Against Mental Health Effects of Climate Change

Young people are disproportionately affected by climate change due to their critical developmental stage and lack of power, and they experience both higher severity and prevalence of mental health issues related to climate change (Cox et al., 2018). This can be attributed to changes in their development: middle and late adolescents are moving away from more rigid structures of thinking to more abstract ideas and thoughts about the future (Allen & Waterman, 2019). So, while adolescents are becoming more cognizant of the short- and long-term effects of climate change, their lack of autonomy and voting rights leave them largely dependent on adults for decisions about and access to resources to protect themselves from these effects (Cox et al., 2018). According to the U.S. Department of Health and Human Services (2021), adolescents are particularly sensitive to influences from their social environment and in turn, mental health issues may start or peak during these years with potential lifelong consequences. Hickman (2021) conducted a global survey of 10,000 young people, ages 16 to 25, and found that two-thirds felt sad, afraid, or anxious about climate change. These survey results are supported by the findings of Coffey and colleagues (2021), who found a higher prevalence of eco-anxiety among young people, ages 18-35, compared to adults, 35 or older. Additionally, the worry about climate change among older adolescents in recent years has been increasing (Hickman, 2020; Kaplan & Guskin, 2019). They, along with children and younger adolescents, have been and will continue to be greatly impacted by climate change.

There is hope in this chaos, as youth engagement in climate change activism can result in the growth of resilience, leadership skills, and collaboration (Cox et al., 2018). Researchers suggest that eco-anxiety can lead to a constructive response, which focuses on engaging in positive situations that reduce worry (Verplanken et al., 2020). Emerging literature has found that following climate-related disasters, children may experience post-traumatic growth if properly supported by caregivers to reflect, grieve, and articulate feelings on climate (Clayton et al., 2017). Even outside of disaster situations, adolescents reported action opportunities

mitigating negative emotions around climate change. Taking informed action helped adolescents feel part of a larger collective shift towards sustainability while also increasing personal motivation, self-confidence, and self-efficacy (Trott, 2022). As seen with recent global youth climate strikes, worry about climate change can lead to powerful action among young people (Bouilanne et al., 2020; Kowasch et al., 2021).

2. A Context for Talking to Youth About Climate Change

2.1 Something Special: What Needs to Be Considered in Communication to Youth

2.1.1 Adolescent Brain: The Power and the Pain of Adolescent Neurological Development

Not only are adolescents' brains changing at a rapid rate, but disparate growth rates in different segments of the brain, while experiencing higher levels and different responses to hormones, can result in particular responses to learning and communication that may be specific to this developmental stage, and should be taken into consideration when communicating with youth on climate change and encouraging activism.

Neurologists have noted adolescent brains are both more powerful, with an incredible capacity to learn, but also more vulnerable. Both these facts are due to their neural plasticity (Jensen & Nutt, 2016). Memories last longer and are easier to make during the adolescent years, making it the ideal time to invest in emerging talents and for remediation for learning or emotional issues (Jensen & Nutt, 2016). While learning is at its most efficient, self-discipline, task completion, attention, and emotional regulation are still generally inefficient (Jensen & Nutt, 2016). For this reason, simple messages, focusing on one or two points may be particularly appropriate for this age group. Adolescents may be less able to accurately weigh the risks of more extreme activism (e.g., radical, illegal) due to underdeveloped impulse control (prefrontal cortex), in combination with the heightened response to potentially novel experiences (sensation-seeking/ sensitivity to dopamine) (Jensen & Nutt, 2016). Hypersensitivity to dopamine also makes them more responsive to immediate rewards, even if small, than larger

delayed rewards (Jensen & Nutt, 2016), so finding opportunities to highlight small wins may be especially valuable to encourage ongoing activism.

The effects of stress on learning and memory can predispose adolescents to mental health problems, so protecting youth from the effects of eco-anxiety and building resilience capacity may be particularly critical. Chronic stress, as seen with eco-anxiety, may have significant lasting effects on adolescent brain development (Jensen & Nutt, 2016; Baker et al., 2014). Adolescents have an overactive stress-response system, which makes them less able to handle emotions, especially in a crisis situation (Jensen & Nutt, 2016). They are less protected against stress than adults due to different levels and responses to stress hormones, making them prone to respond with more extreme emotions (Jensen & Nutt, 2016; Baker et al., 2014). Anxiety disorders often emerge during adolescence, with an estimated 2-9% of U.S. adolescents having some type of anxiety disorder, with girls having higher rates and earlier onset (Jensen & Nutt, 2016). There is also a strong connection between anxiety and environmental stressors (Jensen & Nutt, 2016), further highlighting the importance of supporting those adolescents who may experience more direct effects of climate change. Adolescents are less capable of “fear extinction,” because of the immaturity of the amygdala, prefrontal cortex, and hippocampus, which is a risk factor for anxiety and stress-related disorders (Dou et al., 2019; Johnson & Casey, 2015; Baker et al., 2014). This leaves adolescents more prone to developing PTSD (Jensen & Nutt, 2016). Prior exposure to trauma, like systemic racism, climate disaster events, or physical or emotional abuse, may exacerbate this (Jensen & Nutt, 2016; Baker et al., 2014). However, the amazing plasticity of the adolescent brain also gives hope: they have high resilience, are better equipped to learn to positively respond to stress (Jensen & Nutt, 2016), and interventions can help trigger brain activation and development in critical areas (Naar & Suarez, 2021). Because of this, it is important to destigmatize mental health concerns in general, but especially to acknowledge the toll that frequent thought about the climate situation

or activism may have on an adolescent. We must arm adolescents with the skills to protect their mental health- take care, take control, take time out.

2.1.2 Sweet Sensation: An Important Driver of Adolescent Behavior

Sensation-seeking, the desire to seek out novel experiences, increases starting in early adolescence and peaks at around 19 years old (Blakemore, 2018) and can be an important driver of adolescent behavior. Dramatic brain remodeling in early adolescence results in heightened sensitivity to rewards, including “reward anticipation,” or the prediction of potential rewards (Chein et al., 2010). Correlation was found between activity in these “reward anticipation” brain regions and self-reported risk-taking in adolescents (Chein et al., 2010). This may be an important developmental factor to harness in adolescence. While risk-taking is often disparaged because of its association with unhealthy activities like substance use and unsafe driving, the ability to positively harness these same neurodevelopmental changes is key for enabling adolescents to take the risks necessary to develop their personal identity and values, establish autonomy, build healthy relationships, and learn new skills (Duell & Steinberg, 2021). Especially for those youth inclined to greater sensation-seeking, climate activism may be an opportunity to direct these risk-prone adolescents in a safe, structured opportunity to meet their desire for novel, exciting risks in a developmentally adaptive way. Both positive and negative risk-taking have been found to be associated with higher sensation seeking (Duell & Steinberg, 2020). Positive risk-taking is defined as socially acceptable, constructive behaviors that are not illegal or dangerous but for which the outcomes are uncertain (Duell & Steinberg, 2019). Research suggests engaging in positive risk-taking behaviors that require planning and impulse control can help improve self-regulation skills, personal responsibility, goal-setting, and social competence (Duell & Steinberg, 2021; NAP, 2020). Activism activities like attending group protests or publicly expressing strong feelings about the climate crisis may meet their sensation-seeking drive because of the potential social risks, while also providing constructivist opportunities to practice self-regulation for growth and learning. Additionally, the perception of

being watched by peers has been shown to further sensitize adolescents to the reward value of risky behavior (Chein et al., 2010), which may make supporting opportunities for climate activism with or visible to peers particularly rewarding for this age group. Youth use of and interest in social media may be an easy way to leverage this, as a potentially “always watching” representation of peers. Further, the engagement of peers in positive behaviors shows preliminary evidence it may reduce negative risk-taking (Duell & Steinberg, 2021). Therefore, youth climate groups may serve an important function of amplifying each others’ positive risk-taking and potentially reducing negative risk-taking.

Positive risk-taking may provide an avenue for protection against the negative emotional effects of climate change awareness. A literature review looking at positive risk-taking in adolescents found it may help those suffering from mental health issues by reducing internalizing symptoms, improving negative mood and low energy, helping develop resilience, and increasing positive affect, happiness, and optimism (Duell & Steinberg, 2021) Additionally, the opportunity for choice, autonomy, and opportunities for self-direction in youth-directed climate activism can increase the intrinsic motivation for climate change action, which can be further supported by providing positive performance feedback (Kowasch et al., 2021).

2.2 Theoretical Frameworks for Climate Communication

Three theoretical frameworks were selected to help contextualize both struggles and successes in communicating climate change with youth: the extended parallel process model, action competence in sustainable development, and transformative learning theory.

2.2.1 *Extended Parallel Process Model (EPPM)*

The current recognition of climate change as an impending emergency makes the extended parallel process model (EPPM) a helpful theoretical framework for contextualizing climate change-related messaging and education, the responses observed in adolescents, and a starting point for looking at best practices for communicating to and by adolescents. EPPM is a construct created by Witte (1992) integrating previous theories to explain the processing and

effect of “fear appeals,” and may be helpful in understanding some of the reactions observed to climate change messaging. EPPM breaks message processing into two larger frameworks (Figure 1), **perceived threat** and **perceived efficacy**, and theorizes that a failure in balancing these two frameworks will lead to a failure in achieving desired outcomes. Perceived threat is a shared conceptualization of both the **perceived severity** (how serious or significant a threat is) with **perceived susceptibility** (how likely am I to be affected by it). If an individual does not believe the threat is severe or does not believe they are likely to be affected by it, there will be a failure to perceive a threat and they likely won’t respond. Perceived efficacy, which is further broken down into the component parts of **response efficacy** (belief that recommended response can prevent or lessen the threat) and **self-efficacy** (the belief that I can do the recommended response), is critical to support when threat messaging is successful. If threat messaging is effective, if either no efficacy suggestions are provided or are done in such a way that the audience does not believe they are capable of the actions or the actions will be ineffective, the audience is likely to move into a fear control response. EPPM suggests three common fear control responses: defensive avoidance (ignore the problem), message minimization (claim threat was exaggerated), or perceived manipulative intent (claim threat was manipulative/distorted) (Witte, 1998, as cited in Popova, 2012). This theoretical model provides a rational explanation for “climate deniers,” as well as those that claim the threat is exaggerated, or that disengage entirely: we have failed at adequately conveying both the seriousness of the threat of climate change with the integral piece that we are capable of doing something about it. It also helps to highlight the critical importance of framing climate change issues with a lens of active hope, which is echoed by research (Ojala, 2012). On the other hand, ignoring the threat component of climate change may lead to a lack of motivation to engage in action, which there is some evidence to support in the literature on adolescents (Ojala, 2012). Considering the reduced capacity for adolescents to manage fear response and susceptibility to anxiety and other mental health issues, the use of threat/fear messages on climate change may want to be

used with caution with adolescents, and with a greater emphasis on efficacy components. Another distinct weakness of EPPM is the recognition that youth, in particular, may not know how to take the actions necessary to evoke change, even if they have belief in its importance and their ability to do so, so additional message components to address this may be particularly important.

Figure 1
Extended Parallel Process Model (Popova, 2012)

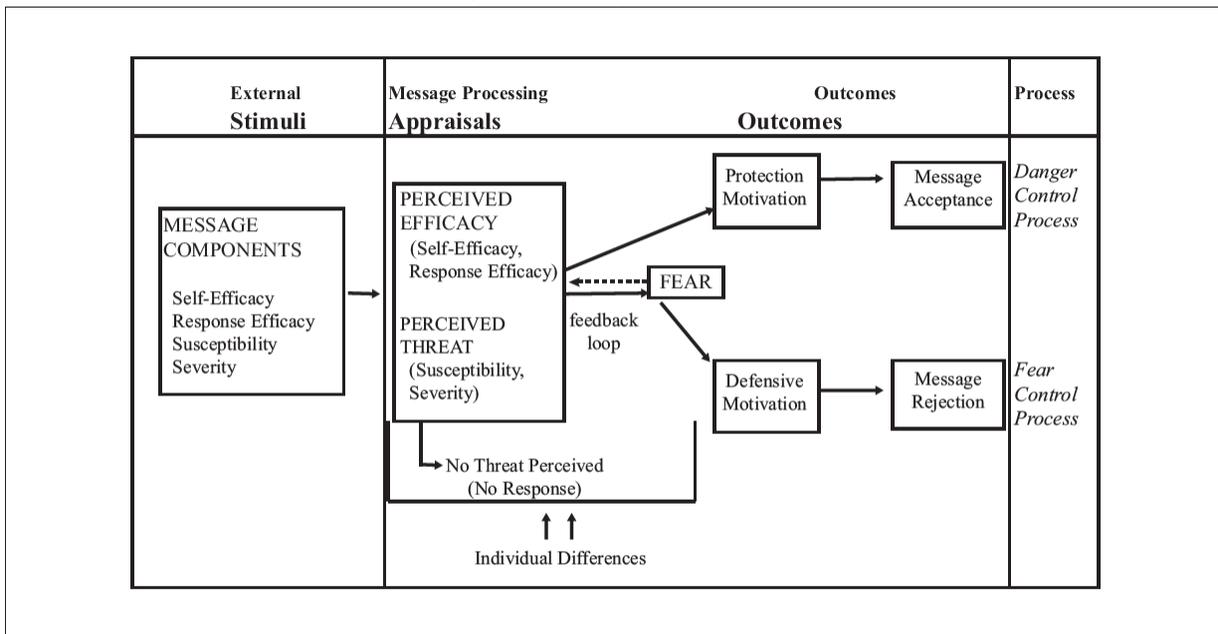


Figure 1. The extended parallel process model
Note. Reprinted with permission from Kim Witte (1998).

2.2.2 Action Competence in Sustainable Development (ACiSD)

Action competence in sustainable development (ACiSD) is a framework that focuses on action and is also considered a valid outcome variable to measure effectiveness of sustainable development (SD) education (Sass et al., 2022). ACiSD overlaps with EPPM, with **outcome expectancy** being largely analogous to response efficacy, and **capacity expectations** to self-efficacy in EPPM (Figure 2). ACiSD also expands on the perceived threat component of EPPM, as **willingness** to contribute to SD (commitment and passion to solve issue) allows for both positive framing as well as the negative framing (threat/fear) inherent in EPPM, as well as implying internal rather than external motivation. This may make it a particularly valuable

framework to use for climate communication for adolescents in consideration of their higher susceptibility to anxiety and lower ability to manage fear (Baker et al., 2014), which EPPM may elicit. ACiSD adds the component of **conceptual knowledge** of SD action possibilities (knowledge of the issue, action possibilities, and related individual or societal norms) (Sass et al., 2020). As a newer theory, how willingness is invoked in students is still being explored (Sass et al., 2022, Olsson et al., 2022). Olsson et al. (2022) argue a critical element of ACiSD is the opportunity to take on real sustainability issues in a democratic and pluralistic way. Providing opportunities to show leadership, make decisions, and be actively involved while interacting with peers and the community will build conceptual knowledge of SD action that will extend beyond the classroom. Action-based initiatives serve to empower youth as agents of change in their family and community. To this end, climate communication to youth should also provide opportunities for youth to explore their values and personal connection to climate change to foster the willingness to take action.

Figure 2

Action competence in sustainable development (ACiSD) (Sass et al., 2022)

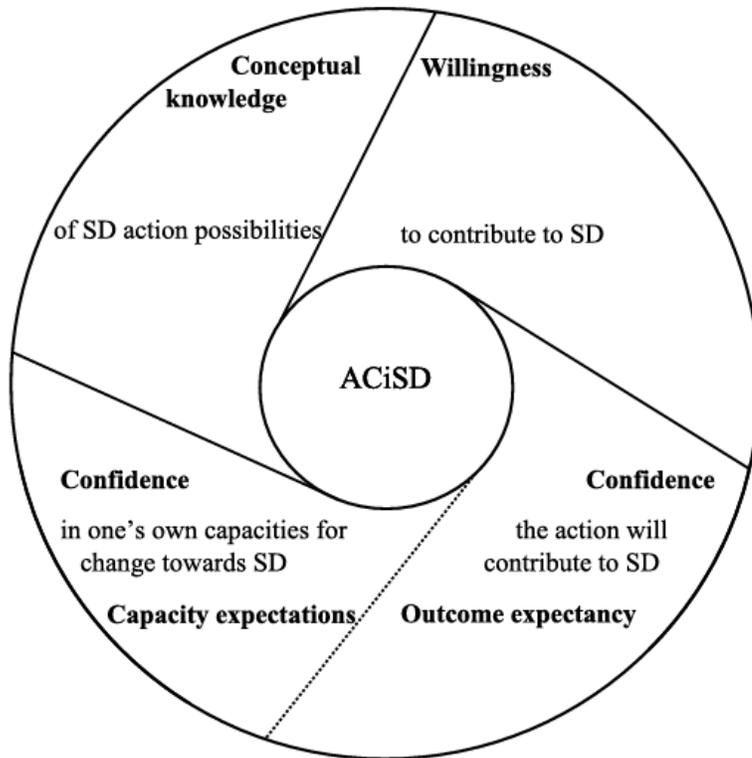


Fig. 1 Core features of ACiSD (after Sass et al., 2020) Note: SD = sustainable development

2.2.3 Transformative Learning Theory (TLT)

Transformative learning theory (TLT) is a framework originally developed by Mezirow (1978) and may better illustrate the processes a student must go through to move from a perspective of ignorance or apathy to one where they are willing to take action. It is organized under a broad model of simultaneous attention to the **heads** (cognitive engagement), **hearts** (affective enablement), and **hands** (behavioral enactment) of students (Figure 3), and emphasizes experiential, collaborative, and action-based learning supported through critical reflection, dialogue, and action opportunities (Trott, 2019). TLT integrates and extends the concepts of EPPM and ACiSD through its understanding that exposure to information on the risks of climate change (EPPM perceived threat) can lead to a “disorienting dilemma” (Trott, 2022). While often accompanied by a sense of alienation, if supported to psychologically process through dialogue and/or opportunities for action (EPPM self-efficacy/ ACiSD capacity expectations), this may be a critical step to the perspective transformation necessary for

sustained engagement (ACiSD willingness). However, a failure to provide these supports may lead to apathy and disengagement described by EPPM’s Fear Control Process. The implication for climate communication is the need to make space for deeper discussion and reflection, the “heart” component, while also still addressing the more clear-cut “heads” and “hands” components addressed in the simpler EPPM and ACiSD models respectively. One intriguing suggestion is to use art to meet this need. Art is often recognized for its ability to evoke an emotional response, but Roosen et al. (2018) suggest art also embodies narratives, metaphors, and co-creating of meaning that often challenges pre-conceived ideas and may facilitate both openness to new ideas and processing. Recognition of the value of art to the activism space also opens up participation to youth that may feel excluded when it is overly focused on a discussion of scientific principles.

Figure 3
Transformative Learning Theory (TLT) in SCA (Trott, 2019)

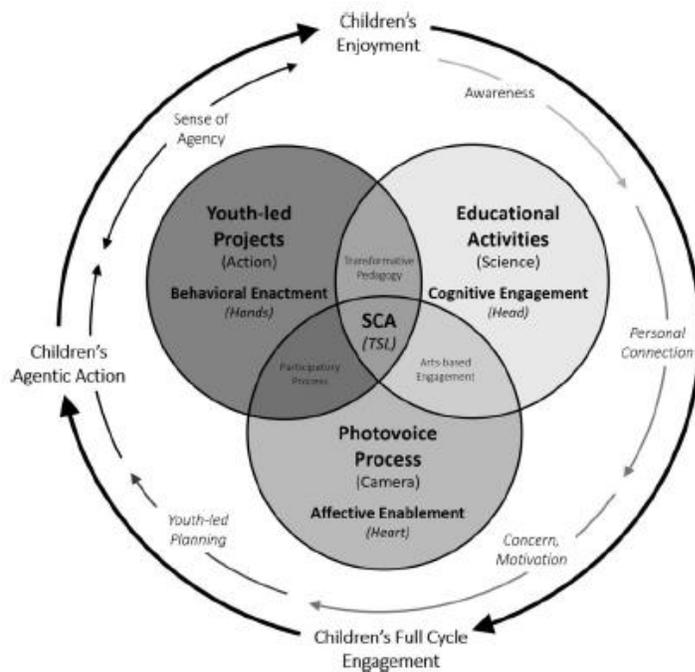


Figure 2. Conceptual model of children’s constructive climate change engagement through SCA. Critical dimensions include: (1) Children’s Enjoyment, which promoted children’s active participation and sustained engagement and (2) Children’s Agentic Action through youth-led projects in both household and community contexts, which served to strengthen children’s sense of agency.

2.2.4 Theory in Action

Two excellent examples following the principles of TLT were found in the literature: a “Science, Camera, Action!” (SCA) program for young adolescents that was expressly built off the TLT framework (Trott, 2019 and 2022), and a college-level public service announcement (PSA) project for a climate class whose material has been made publicly available and is anecdotally reported to have also been successfully used with middle and high school students (Rooney-Varga et al., 2014). A diagram detailing the integration of TLT in the SCA program is presented in Figure 4 (Trott, 2019). The PSA project does not mention any particular theory it was built on, but the discussion of the project does suggest many of the overarching concepts in TLT were present. Both examples incorporated an artistic media project in a larger climate education curriculum. The students were given agency to choose subject matter they had a personal connection to, as well as in the creative process. The process of both creating and presenting their media projects to others provided opportunities for discourse and deeper engagement with the material. Both studies fostered age-appropriate 21st-century skills like developing communication skills, group work, and addressing complex real-world problems while also showing evidence of affecting perspective shifts, hallmarks of TLT. The SCA study reported medium effect sizes on the students' feelings of connection with nature ($d=0.43$), environmental responsibility ($d=0.47$), and a small to medium effect on their attitudes towards the urgency of climate change ($d=0.36$). The PSA study also showed gains in climate literacy of students, but as the project was part of a larger course on climate change it is more difficult to tease out what gains are directly attributable to the PSA project. The researchers reported student surveys consistently ranked the project as one of the assignments that promoted the most learning and one of the best parts of the course, with 87% ($n=55$) recommending its inclusion in future courses (Rooney-Varga et al., 2014). Additionally, 68% ($n=34$) stated creating the PSAs affected their attitude and opinion about taking climate change action, with the majority who said it did not change their stance stating it was because they were already

planning on taking action. While not an original study intent, Rooney-Varga et al., (2014) also reported positive effects on climate change concern, interest, and motivation to seek additional information in screening audiences of the PSAs, both in-person and online.

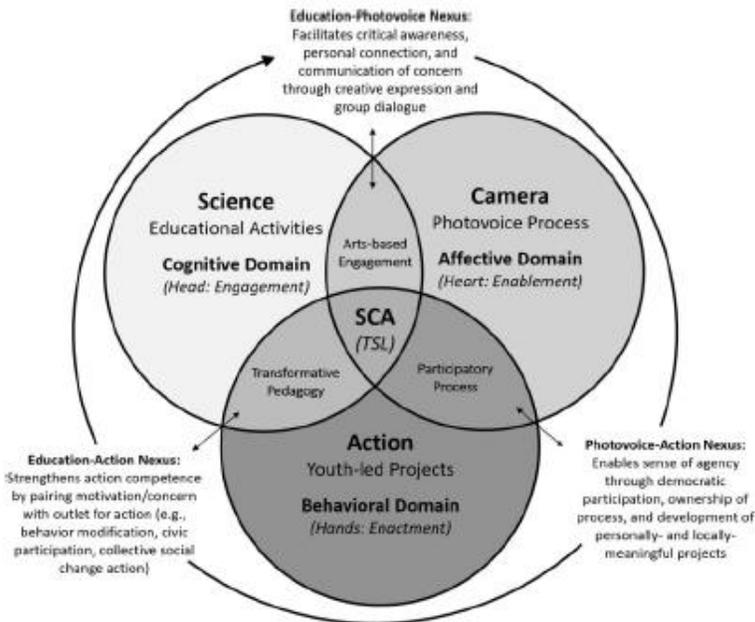


Figure 1. Towards facilitating children’s constructive climate change engagement, the primary components of the Science, Camera, Action! (SCA) program integrated transformative pedagogy with arts-based and participatory methodologies, grounded in the Head, Hands, and Heart Model for Transformative Sustainability Learning (TSL; Sipos et al., 2008).

Figure 4: Transformative Learning Theory (TLT) in SCA (Trott, 2019)

3. Communication Breakdown: What Works and What Doesn’t in Communicating Climate Change to Adolescents

Recent literature reviews assessing climate communication to youth show areas where we can do better for our youth and promising guidelines educators can use to help engage youth with this important issue. Of note, very little research on direct communication to youth on climate change was identified, so this section focuses on research assessing climate change education research.

3.1 Communication Breaking Down

A few themes recurred in the literature as *not* working to successfully engage youth: an overemphasis on facts in climate change communication, lack of self-directed learning opportunities, and the politics around climate change.

3.1.1 *Facts, and Nothing But The Facts*

Studies have shown that scientific knowledge alone is not enough to engage pro-environmental behavior (Busch et al., 2019; Merritt et al., 2022; Rousell & Cutter-Mackenzie-Knowles, 2020), and only a small fraction of pro-environmental action seems to be directly linked to environmental knowledge (Kollmus & Agyeman, 2010). Focusing on facts alone ignores the possibility that interpretation of the facts can vary, or that facts can be ignored, both current struggles in the current widespread discourse on climate change. Critical reflection and dialogue embedded in TLT may be an important focus to help ameliorate this (Trott, 2019). On the other hand, documentaries, films, and other art forms on climate change have been shown to shift attitudes on climate change, but potentially leave people floundering as they don't know what to do about it (Rousell & Cutter-Mackenzie-Knowles, 2020). Integration of the ACiSD framework may be a valuable way to address this by assuring action is at the heart of communication initiatives. Researchers Rousell & Cutter-Mackenzie-Knowles (2020) argue too much emphasis is placed on understanding climate change, when more important is empowering youth to mitigate it. Students must be given not “just the facts” but also “the actions” (Monroe et al., 2019).

3.1.2 *Insufficient Autonomy*

The desire for autonomy is particularly strong, and developmentally appropriate, in adolescents. Low autonomy climate change education (CCE) programs were found to have fewer positive outcomes (Merritt et al., 2022). Autonomy is considered a critical developmental need in adolescence (Duell & Steinberg, 2021; Jensen & Nutt, 2016). In the education setting, **low autonomy activities** frequently result in students just passively receiving information

(Merritt et al., 2022), which often results in lower engagement and retention of information. Providing opportunities for self-directed learning can help fulfill adolescents' developmental needs while also increasing the chance they can focus on material they find more personally relevant. A combination of autonomy with structured support focusing on specific knowledge and skills relevant to understanding challenging ideas or building new skills was recommended (Merritt et al., 2022).

3.1.3 The Complication of Politics

It is worth noting that multiple articles on CCE mentioned difficulties due to the **politicization** of climate change (Rousell & Cutter-Mackenzie-Knowles, 2020; Monroe et al., 2019; Lawson et al., 2019, Trott et al., 2022). This complicates educators' ability to teach an already complex subject by climate change beliefs conflation with socio-cultural factors, and perceived threats to the values and identities of some students or their parents by teaching it (Monroe et al., 2019). Concern for political backlash from families or community members was suggested as limiting educators' willingness to tackle the political discourse and advocacy for action around climate change (Rousell & Cutter-Mackenzie-Knowles, 2020; Monroe et al., 2019). At the same time, other research has expressed the importance of centering CCE in a political context to accurately convey the need for political and collective action, as opposed to individual action, to achieve the changes necessary (Kranz et al. 2022). This leaves educators stuck between a political rock and a hard place.

3.2 Hall of Fame: Evidence-Based Frameworks for Successful Climate Communication Education

Existing literature reviews have identified several key aspects of effective CCE.

A systematic review by Monroe et al. (2019) of 49 articles published before November 2015 identified factors for effectiveness in CCE. Two larger themes were identified to improve program success: making climate change **personally relevant** and meaningful to the learner, and formats to actively **engage learners**. Many of the examples of making “personally relevant”

focused on local impacts. Engaging learners was often done through inquiry-based, experiential, or constructivist teaching methods, which were recognized as generally effective for science or environmental education. Four additional strategies were suggested to help move learners to a deeper understanding of climate science: **deliberative discussion**, opportunities to **interact with scientists/experience the scientific process for themselves**, specific design to **address misconceptions about climate change**, and engaging in designing/implementing **school or community projects** on some aspect of climate change. Structured social interaction, via small group discussions and investigations, also seemed to facilitate understanding and recognition of knowledge gaps, potentially opening the door to address misinformation/misconceptions, particularly the “how do we know” talk, where students practice making a claim and supporting it with evidence (Monroe et al., 2019). Collaborations with scientists served to not only engage students but also showed evidence of increasing the confidence of educators in facilitating student exploration and empowered students to learn more and take action. Suggestions for further research included looking at the relevance different ages/developmental stages may have on how to approach misconceptions or the relevance of highlighting different climate impacts.

A literature review by Rousell & Cutter-Mackenzie-Knowles (2020) on CCE for youth published from 1993 to 2014 highlights similar areas to focus on: learning that is **experiential**, **participatory**, **interdisciplinary**, and **affect-driven** may be effective in shifting attitudes and actions in youth (Rousell & Cutter-Mackenzie-Knowles, 2020). This review also highlighted the growing tension between knowledge-based CCE programs and the more complex but arguably more effective interdisciplinary and experiential approaches, particularly in primary and secondary education classrooms. They argue the latter is necessary to adequately prepare students to understand and address the social, ethical, political, and scientific complexities of this issue (Rousell & Cutter-Mackenzie-Knowles, 2020). An interesting emerging area of research mentioned in this literature review was relevance of indigenous knowledge for CCE

(Rousell & Cutter-Mackenzie-Knowles, 2020), which not only provides a different context with which to view this complex topic, but also may support greater environmental justice awareness.

In a systematic literature review of online programs with evidence of enhancing environmental literacy, Merritt et al. (2022) identified three overarching themes for success with 12 guiding principles: **fostering connections** (social-ecological connections, relevance, social interactions, role models), **supporting learner agency** (autonomy, active involvement, challenge, use of multiple modalities, positive framing), and **completing the experiential learning cycle** (preparation, feedback, and reflection). The inclusion of culturally relevant content was mentioned as particularly beneficial for historically marginalized, at-risk, or underserved students. The authors include action steps in their greater definition of environmental literacy, and highlight how advancements in technology allow remote instruction to potentially include much more interactive components than were previously possible. Online activities can also enhance in-person events by providing effective pre and post-visit opportunities to extend the learning, by preparing for or following up on the in-person learning (Merritt et al., 2022). Beyond the importance of remote CCE options during the COVID-19 pandemic, remote CCE expands the reach of programs to those who face geographical, physical, or financial constraints that limit access to in-person options, as well as opening up the capability to observe climate issues on a broader scale. Enhancing connection to places both near and far experiencing the ravages of climate change may increase the motivation to protect those places.

4. Youth Climate Communication

Research on direct communication to youth on climate change is sparse. This is unfortunate, as there is the suggestion that a lot of direct communication may be seen by adolescents via digital media. Adolescents are high users of digital media, with use increasing since the COVID-19 pandemic. In a 2021 poll by Commonsense Media, youth 13-18 years old are spending an hour and a half on average per day on social media, with the most commonly

ever-used social media sites being Youtube (83%), Instagram (70%), Tiktok (68%), and SnapChat (64%), respectively, and one in five say they listen to podcasts at least weekly (Rideout et al., 2022). Therefore, digital media can be an important tool to reach youth for knowledge transfer, to help shift cultural norms to portray pro-environmental behaviors as popular and normative, and provide a potential storytelling platform to engage their hearts and minds.

Climate change communication expert Edward Maibach suggests two guiding heuristics in messaging: for knowledge transfer, “*simple clear messages, repeated often, by a variety of trusted sources,*” and to convert intentions into actions: “*make the behaviors we are promoting easy, fun and popular*” (2015, p.3). Maibach further suggests messages should be tailored to the intended audience: their views, values, and “language” at the forefront of message design, putting the messages where they will reach your audience, and ideally given by trusted messengers (Maibach, 2015). Another communication strategy suggested for effective climate communication is the use of storytelling. Bloomfield & Manktelow (2021) suggest the following guidelines for framing stories on climate change: including clear and specific settings (like the use of local examples), characters (people and governments), and morals (specific goals). They further highlight the value of analogies and comparisons to explain scientific concepts to facilitate understanding, retain information, and help people “see” themselves as affected by climate change. We use these expert guidelines as well as the frameworks and theories discussed above to look at current climate communication to and by youth.

An analysis of 100 videos on TikTok tagged with #climatechange had over 200 million combined views, and while only 8 of 100 cited credible sources, 93 of 100 presented climate change as real (Basch et al., 2022). Of interest, the next two most common themes found in the videos were mention of affected populations (76%) and climate anxiety/frustration (57%) (Basch et al., 2022). There was not enough other detail reported to see if sampled videos adhered to other principles of effective adolescent communication. Separate research in older adolescents

suggests there is a desire for climate content on digital media from credible sources and coverage of the issue that is hopeful, and that impact of content may be improved by making it visually stimulating and including microblogging (Parry et al., 2021)

An article looking at the theoretical foundation for positive effects of the documentary film series *Young Voices for the Planet*, short films on youth environmental activists by filmmaker Lynne Cherry, discussed qualitative evidence supporting its positive effects (Bandura & Cherry, 2020). The films are another example of the remarkable ability youth have to educate and inspire action in others, which the authors ascribe to the power of social modeling, youth seeing “someone like them” creating environmental change, to build perceived efficacy (Bandura & Cherry, 2020). By the very nature of using this film series format, they use a storytelling framework that emphasizes the conceptual knowledge of action for SD. The films further support youth action by publication of a related website with a “Take Action” tab which links to other resources, including a guided lesson for youth to create their own action plan and practical tips to initiate it, or links to join existing environmental groups or projects, as well as an educator curriculum (Young Voices for the Planet, 2022). The curriculum guides the educator to help students analyze the films and create their own action plan, encouraging collective efficacy through suggestions to create a team with those who share their interests (Bandura & Cherry, 2020), and following principles consistent with TLT to facilitate personal connection and agency.

In the course of researching this subject, two other programs were discovered that are youth created or focused, and a selection of their published online content was analyzed for its consistency with the communication principles discussed in this article.

The Environmental Justice Coalition (EJC) is a youth-created coalition focused on environmental justice. They publish a website, have a public Instagram (IG) page where they post environmental justice content, an ezine on Medium, and they recently started hosting a podcast, as well as engaging in grassroots activism and policy advocacy (EJC, 2022). The use of cross-platform, multimedia formats is an effective way to meet adolescents where they are. A

brief analysis was done of their most recently published Instagram and Medium posts for their adherence to the communication best practices for adolescents discussed here. Of particular note was the absence of youth at the fore, which means they miss out on potentially offering social modeling to other youth for the great work they are doing. Of the posts viewed, none of them had pictures of youth or otherwise indicated this was a youth-directed coalition. EJC has posted 76 Instagram posts as of July 25, 2022, of which the most recent seven were analyzed. EJC did an excellent job of focusing on credibility by posting sources on the last slide of each, and having a linktr.ee in their IG bio to be able to link additional materials and reference sources. A linktr.ee (<https://linktr.ee/>) is a single link that opens a page where additional links can be added in a user-friendly interface. However, the communication to engage fellow adolescents could likely be better supported. None of the links through the linktr.ee provide any direct options for action (<https://linktr.ee/environmentaljusticecoalition>). The post content tended to focus on facts, and chances for engagement or action were only mentioned in two of the seven posts analyzed, although another two were framed around positive actions by people or scientifically (IG/EJC, 2022- <https://www.instagram.com/environmentaljusticecoalition/>). There were also surprisingly few pictures posted for a social media site focused on visuals. A number of the posts were relatively text-heavy with simple graphics in the background. Better use of pictures related to the subject matter may help to engage audiences and help emotionally connect to the content. Similar techniques were seen in the EJC articles on Medium: of the four articles analyzed (of a total of 31 posted), only two offered clear suggestions for action, although the ones that did provided excellent links to resources that facilitate a wide range of possible actions (<https://medium.com/environmental-justice-coalition>). There was also a heavy focus on facts, with low use of visuals to help foster understanding and connection to the material. The exception to this was a story on an Indigenous tribe's struggles over sacred land with a university: this was nicely framed with a storytelling format and relevant pictures, but had an abrupt and unclear ending and only vague suggestions of what an individual can do.

The other youth-focused communication analyzed was by the Alliance for Climate Education (ACE, 2022). ACE is a 501c3 company that describes their mission as educating, inspiring, and supporting young people “to lead the fight for their future” (ACE, 2022). They appear to be a much larger budgeted program with more sophisticated climate communication techniques. While they did not have a direct social media presence, they did have a “Creator Collective” that their strategic plan highlighted as “coordinated storytelling” by youth influencers on social media (application required a minimum of 200 followers) to provide repeated simple messages from trusted (fellow peer) sources, as suggested by Maibach (2015). Additionally, the selection of social media messages sampled from highlights on the ACE website had a clear, simple call to action (e.g., sign petition through link in bio) and contextualized the issue as local, either physically or as “our generation.” Where they particularly shined, however, was in their visually stimulating, youth-centered content on their website and its integration to convey both threat and youth efficacy with opportunities for action with a minimum of barriers (<https://acespace.org/>). They conveyed climate threat and youth efficacy through a series of longer form videos, with a focus on BIPOC (Black, Indigenous, and People of Color) youth activists, that were also clearly labeled by state, to jointly facilitate finding personally relevant stories and highlight the widespread and disparate effects of climate change. Action was facilitated by a page of clickable active campaigns on a page where they could also be filtered by geographic location or area of work (<https://acespace.org/climate-advocacy/>). The campaign activities highlighted in July of 2022 were mostly petitions, but there were also links to support contacting your local, state, and national government representatives. The links to contact government representatives included a web-based form which identifies your respective representatives based on your address, and pre-filled but editable emails that can be sent to all or a subset of your representatives. They also offer the opportunity and support to take part in in-person activism via their Action Team Network, which is stated to also include training and the opportunity to “get to build power within their communities, and lead actions like rallies and

lobby days.” (<https://acespace.org/action-team-network/>). There also appears to be a newer focus on climate anxiety, with recent articles with youth activists asked how they cope with it or protect against it, as well as a sub-page to talk about it and provide climate-related mental health resources (<https://acespace.org/lets-talk-about-it/>). This “Let’s Talk About It” sub-page is also an excellent example of minimizing barriers to participation. To encourage youth voices to “share [their] truth” on climate anxiety or tips/strategies “for resilience,” which will help to normalize and destigmatize this phenomenon, they have embedded a video with subtitles to walk through clickable steps to record them directly on the website (video, audio, or text). This largely removes or sharply decreases barriers due to literacy (both technological and reading), as well as self-efficacy, particular with a small note encouraging “practice.”

While a lot is still to be learned about the best ways to communicate climate change with adolescents, particularly in ways to spur them to healthy action, these examples are heartening examples of the amazing possibilities when youth are supported and encouraged to use the special passion and abilities of this developmental period in positive ways.

Methods

Research Strategy

This project included a scoping literature review using scholarly databases to examine emerging evidence on communicating climate change issues with adolescents and identify key characteristics or factors for success, particularly to facilitate climate action. A secondary area of focus for the review was best practices to support adolescents to communicate their own messages on climate change, as a potentially important but lower threshold activity to engage youth action. Literature was reviewed for both general education principles deemed important for successful engagement of adolescents, as well as for research specific to climate change education or communication. Searches were also done to locate peer-reviewed articles, reports, and books focused on understanding adolescents and promoting education and behavioral change best practices in this important developmental stage. Behavior change or educational

models, frameworks, interventions, or programs suggested as effective for improving communication or instigating action around climate change were researched with an eye toward offering a framework to synthesize common construct threads and potential alignment across the frameworks. This portion of the search included grey literature published by groups focused on work with youth/adolescents, and specific research directly related to climate change or environmental education. The focus was on research published after 2005, due to the changing information and political climate of the subject matter, as well as recent advances in understanding adolescent neurodevelopment.

Target Population

Adolescents, age 10-19

Keywords

Initial search keywords included: (climate change or global warming or greenhouse effect or climatic changes or weather) and (youth or adolescents or young people or teen or young adults), and variations on terms to focus content like “activism”, “content analysis”, and “communication.”

Additional searches were done on frameworks or models identified in the literature, like the extended parallel process model, action competence in sustainable development, and transformative learning theory.

Databases

Multiple databases were searched using the Ebsco Discovery Service (Fusion), a web-scale discovery system, through the University of San Francisco Gleeson Library, which at the time of this review was inclusive of more than 60 databases (e.g., Complementary Index, Academic Search Index, SocINDEX, Education Source, Environment Complete, Springer Nature Journals, CINAHL, MEDLINE, APA PsycInfo, Scopus), and Google Scholar. The search also included gray literature focused on contextualizing adolescent development, best practices to work with youth/adolescents, and specific research directly related to climate change or

environmental education. Results were limited to publications in English from the years 2005-2022.

Additional articles were identified by reviewing related research suggested by database algorithms, and pulled from the reference lists of relevant literature.

Exclusion and Inclusion Criteria

Inclusion criteria: Peer-reviewed articles, Available in English, Age range:10-19, Publication year: 2005-present

Exclusion criteria: non-English articles, articles not related to climate change, communication, or youth education or youth development.

Recommendations

This literature review has highlighted advances made in understanding adolescents' needs in communicating climate change issues and promoting activism, but it also highlights the many areas where there are still gaps in our understanding, practice, or policy to meet these needs.

Research Recommendations

While there has been significant progress in recognizing that adolescence is a developmental stage with distinct needs, strengths, and vulnerabilities, the picture is still very much incomplete.

Understanding Intra-Adolescent Developmental Stages

While there is strong evidence presented in this paper showcasing how adolescence is a distinct period of development, with different strengths and vulnerabilities, research has also alluded to potentially distinct intra-adolescent periods (Fryt et al., 2021; Jensen & Nutt, 2016). Multiple reviews suggest the importance of tailoring programs to cognitive ability or age (NAP 2020; Krauss et al., 2016). One issue with this is the potential confounding of age and developmental stage. While there may be average ages when certain developmental stages are commonly reached, certain adolescents may develop faster or slower, as well as face inter-

gender differences. Those mismatches can reduce the effectiveness of tailored programs for individuals that go solely on age (Krauss et al., 2016). While likely more administratively challenging, research suggests the developmental stage should be used, rather than chronological age, for choosing appropriate programs. Further research should focus on elucidating these differences across the developmental span, as well as determining what differences are mediated by puberty (influence of sex hormones) versus developmental age (Baker et al., 2014). This may be particularly critical for behavioral health interventions, due to emerging evidence of both the critical window adolescence may be for both development of lifelong mental health struggles as well as interventions that may minimize or reverse these effects. Additionally, different communication practices may be more effective at different developmental stages. A better understanding of these differences and development of a screening tool to help determine which stage an adolescent is in may help target interventions to when they will be most beneficial and effective.

Assessing the Function of Positive Risk-Taking

The possibility of climate activism serving a developmentally adaptive role to provide positive risk-taking opportunities for adolescents is intriguing. Additional research should be done on positive risk-taking to better understand its role in adolescent development, as well as how best to leverage its potentially mitigating effects on mental health struggles. Research should also be done to ascertain if positive risk-taking can supplant negative risk-taking behaviors. More exploration should also be done on how to harness its potential benefits for all adolescents, as research has found lower rates of positive risk-taking by both race and psychological temperament (Duell & Steinberg, 2021). Particularly in the case of the lower rates found in BIPOC youth, assessment should be done on whether this is due to systemic difference in access to and opportunities for positive risk-taking, cultural differences in what is considered socially acceptable, or some other cause. If this difference is determined to be disparate access or cultural differences, work should be done to find culturally appropriate ways

to provide these opportunities. All youth would be served by adults having a better understanding of how to structure the environment for adolescents to harness the benefits of positive risk-taking.

Evaluation of TLT for Motivating Climate Activism in Youth

As a theory more recently modified for use in climate change education, TLT shows promise of broad positive effects (Trott, 2019 and 2022). TLT should be assessed for its effectiveness in motivating youth across diverse populations, for both short and long-term climate activism. Additionally, as it is a more complex model, assessments should aim to determine what portions are most significant in effecting change to facilitate ease of use by climate educators. It is important to recognize educators often face conflicting demands and limited time with learners, so the ability to hone in on critical features may increase its use and acceptance as an educational model in this field. Additionally, the operationalization of TLT may facilitate standard measurements to compare the effectiveness of key factors between programs.

Additional areas of research suggested by this scoping review include: better understanding of the prevalence and severity of eco-anxiety in youth; in light of the potential risk/increased susceptibility to fear, what types of positive framing may help encourage activism; how adults can facilitate activism opportunities while not minimizing autonomy/agency of youth; and how can we protect youth from possible negative effects of climate activism (e.g., burnout, “trolling”).

Practice Recommendations

In practice, we need to empower youth and normalize talking about climate change. The current struggles against misinformation highlight the need to develop effective science communicators, both in and outside of the climate science realm. To this end, a brief guideline document for youth on climate communication was drafted (see Appendix A). This could be provided to youth climate activists and assessed by looking at changes in confidence levels of

activists of creating climate messages, as well as levels of engagement on digital media with messages created using these guidelines.

The research suggests we also need to incorporate interdisciplinary knowledge and practice, embedded with transformational approaches, in youth education on climate change. For this to succeed, we must make spaces for cross-disciplinary collaborations, and educate non-science educators to feel effective in this realm, especially when many science educators still do not.

To address educators' concern of political backlash if they attempt to tackle the political discourse and advocate for action on climate change (Rousell & Cutter-Mackenzie-Knowles, 2020; Monroe et al., 2019), educators should receive guidance on educational techniques that help to remove the educator as the direct conduit of information. These various learning modalities may help to minimize this as a direct conflict, as well as potentially be more effective at achieving transformative learning by allowing the student to explore their own and others' values in a discursive way. Suggestions included facilitating understanding of other perspectives or projecting future effects through role play or simulation, as well as experiential or social-constructivist learning, where the focus is on learning via discovery or discussion (Monroe et al., 2019).

Additional practice recommendations suggested by the research include encouraging adults to create systematic opportunities for youth activism, involving diverse youth populations in program development and messaging, and destigmatizing mental health concerns in general, but especially to acknowledge the toll that frequent thought about the climate crisis or activism may have on an adolescent.

Policy Recommendations

In the policy realm, it is recommended to involve youth in decision-making processes about climate change policies. They will face the greatest effects, and their particular

vulnerability in this developmental stage should earn them the right to have their voices heard and needs considered on this issue.

Additionally, policy support is necessary to successfully integrate climate change curricula across subjects and disciplines in educational settings to meet transformative learning goals. To help achieve this, climate change education should be a mandatory component of K-12 curriculum. Currently, the Next Generation Science Standards has standards explicitly addressing climate change in middle and high school and proximally addressing climate change at all grade levels (McGinnis et al., 2013), but only 20 states and the District of Columbia have adopted these standards (National Science Teaching Association, 2022). For this to be successful, teachers must receive adequate instruction on climate change. Climate change should be a mandatory component of new teacher (preservice) training, and readily accessible continuing education opportunities on climate change should be provided to existing teachers. In a nationally representative survey of U.S. science teachers (n=1500) in 2015, only three in four middle- and high-school science teachers allocate at least one hour to formal lessons on climate change (Plutzer et al., 2016). Additionally, teachers are not free from political bias. The same survey found 31% of science teachers taught inaccuracies on climate science, and this was strongly correlated with their political ideology (Plutzer et al., 2016). Therefore, incorporation of transformative learning practices in teacher training may also be critical to the success of climate change educational policies.

Implications and Discussion

This scoping literature review took a developmental lens to contextualize the mental health impacts of climate change on adolescents while providing evidence-based guidance on communication about climate change and encouraging activism to meet adolescents needs, for both educators and fellow youth. In the current political climate, where discussion on the veracity and cause of climate change is still often a challenge and can negatively affect initiation of effective policy shifts necessary to address the issue, it can be valuable to look to youth with

their still nascent political ideologies. While some youth are very aware of the disproportionate burden they will carry from climate change, still others are disengaged or unaware. Recent large-scale youth movements on climate change, like Fridays For Future protests, have shown the incredible power of engaged youth. Promoting engagement and raising awareness of climate change concerns through effective communication is an important lever to know how to effectively wield.

Adolescence is a distinct developmental period that research is increasingly showing has unique vulnerabilities and strengths that should be considered when developing climate communication. This life stage may be key for intervention, both for its importance in the development of a civically minded populace (Smetana et al., 2006, as cited by Sass et al., 2022) as well as a period uniquely open to new ideas that are likely to contribute to their long-term socio-political ideology (Schwartz et al., 2011; Lawson et al., 2019). Helping youth foster an identity as pro-environmental and activist is likely to create ripples that will be felt in voting booths, city halls, and business plans for decades to come.

More immediately, research indicates youth stand in a powerful position to shift the perspectives of not only fellow youth but also the adults in their lives. Children stand in a special position of trust that makes parents more open to listening and accepting their views on complex topics like climate change, even in the traditionally most recalcitrant doubters (Lawson et al., 2019). Encouraging girls to be effective climate communicators may be particularly powerful. This is an age where research indicates girls may become victims of stereotypes about their ability to succeed in STEM subjects (Hill et al., 2010). Empowering youth may not only be beneficial for the minds they shift, but the most important shift of how they view themselves.

Adolescents' position of increasing ability to comprehend the difficulties and likely future harms from climate change coupled with their lack of agency and control over their environment makes them uniquely vulnerable to the risks of mental health issues related to climate change

(Cox et al., 2018). Differences in adolescents' cognitive processing and stress response function (Jensen & Nutt, 2016) make it critical that we intervene to provide opportunities for youth to process these emotions and be given opportunities for a constructive response and informed action. This may be especially critical for marginalized youth. As discussed, prior exposure to traumas like systemic racism, climate disaster events, or physical or emotional abuse may cause brain remodeling that makes these youth even more sensitive to these risks (Jensen & Nutt, 2016; Baker et al., 2014). This is compounded by evidence climate change is a threat multiplier for youth from communities of color and/or low-income communities: they face greater risk of experiencing direct effects of climate change, exposure to environmental hazards, and exacerbations of existing health disparities (Chalupka et al.; 2020). Providing opportunities for youth in these communities to build agency and culturally relevant engagement may help to counteract systemic environmental injustices and build community resilience. Effective and accessible interventions to help all youth manage these stressors while their brain is within this special period of plasticity should be an urgent goal.

One intriguing possibility is to use the adolescent drive for sensation-seeking in a strengths-based approach to foster positive risk-taking in the activism realm. While more research is needed to see if this will supplant the desire for negative risk-taking, there is significant emerging evidence that positive risk-taking has positive effects on both development and mitigation of mental health risks for adolescents (Duell & Steinberg, 2021). Climate activism may be a valuable avenue to provide positive, structured opportunities to meet youth's desires for novel, exciting activities. However, preliminary research has indicated there may be psychological and racial differences in positive risk-taking, with research separately showing extraversion and being White are both associated with positive risk-taking (Duell & Steinberg, 2021). A better understanding of the necessary components to meet these desires in a developmentally appropriate way is needed, particularly in how to make this more accessible to

introverted youth and BIPOC youth. From there, guidelines for educators to foster these opportunities should be developed and implemented.

How to talk to youth about climate change may be a challenging needle to thread. EPPM suggests too little focus on the threat of climate change may lead to disinterest, while excessive focus may lead to fear and message rejection (Witte, 1998, as cited in Popova, 2012) or potentially heightening youth's already increased susceptibility to eco-anxiety. EPPM and ACiSD both highlight the importance of arming youth with actions they can do to address climate change when it is talked about. However, the most powerful theory encountered in this research on climate communication may be the transformative learning theory (TLT). While TLT does already have evidence-based support for its use in youth climate change education (Trott, 2019 and 2022), its alignment with many of the larger recommendations from the systematic reviews on CCE suggest it should be more widely used.

My synthesis of recent literature reviews on climate change education (CCE) highlights key considerations to increase youth engagement, with a unifying theme of the need for educators to go beyond just relaying facts on climate change (Merritt et al., 2022; Rousell & Cutter-Mackenzie-Knowles, 2020; Monroe et al., 2019). These reviews mentioned the importance of experiential learning and fostering a connection to the subject through personally relevant examples. The inclusion of culturally relevant content was cited as particularly beneficial for historically marginalized, at-risk, or under-served students (Merritt et al., 2022). The possibility of providing a different context to view this complex topic and awareness of environmental justice through Indigenous knowledge for CCE is an interesting area of emerging research (Rousell & Cutter-Mackenzie-Knowles, 2020). Supporting learner autonomy and agency proved valuable to deepen understanding, like having the opportunity to experience the scientific process for themselves and engaging in designing or implementing school or community projects related to climate change (Monroe et al., 2019). Collaborations with scientists served to not only engage students but also increased the confidence of educators in

facilitating student exploration and empowered students to learn more and take action (Monroe et al., 2019). All three reviews also addressed in some way the socio-emotional context of this subject: the importance of positive framing (Merritt et al., 2022), the need for affect-driven approaches to shift attitudes and actions (Rousell & Cutter-Mackenzie-Knowles, 2020), and the value of deliberative discussion to facilitate understanding other viewpoints and recognition of knowledge gaps, potentially opening the door to address misinformation/misconceptions (Monroe et al., 2019). These reviews also highlight the growing tension between knowledge-based CCE programs and the more complex but potentially more effective interdisciplinary and experiential approaches, particularly in primary and secondary education classrooms. Rousell & Cutter-Mackenzie-Knowles (2020) argue that an interdisciplinary approach is necessary to adequately prepare students to understand and address the social, ethical, political, and scientific complexities of climate change.

As discussed earlier in the review and as reinforced with many of the points in this synthesis, the inclusion of art as a method of climate change communication can help to broaden the audience and the effects. Beyond that, a focus on art opens up the identity of climate activists and climate communicators to youth with identities that are not necessarily science-focused. Roosen et al. (2018) argue that art typically has an interpretative aspect that may lend itself to both help the viewer see themselves in the “story” and facilitate transformative learning, but also that is less likely to be perceived as a direct threat to prior beliefs.

Empowering youth with artistic identities to use their talents to create awareness of climate change and sustainable changes can not only swell the ranks of youth activists, but may help make significant gains in the affective changes of viewers to inspire their action as well.

While the research on direct communication to youth on climate change is sparse, the high and increasing digital media use of adolescents should make this a research priority. It is important health professionals as well as youth climate activists understand how best to leverage climate communication in the digital media sphere to rally action in youth. It is valuable

to leverage social modeling by putting youth at the fore, and this can best be done by helping provide youth guidelines to facilitate their effective climate communication. At the same time, we need to recognize risks of encouraging youths' social media use for climate activism. While social media's reach and ability to foster connections is impressive, there is also a dark side. There is debate about harmful effects like experiencing harassment or cyber-bullying and the triggering of addictive behaviors (Giustini et al., 2018). A content analysis of comments on the most popular YouTube videos of youth climate activist Greta Thunberg showed that 4 in 10 comments contained some form of incivility, with most ignoring her positions on climate change, and focusing instead on personal characteristics like her youth, gender, and Asperger's syndrome (Park et al., 2021). Youth publicly standing up for climate change also put themselves at a heightened risk for social backlash. Ageism, sexism, racism, ableism, and general incivility may be used to undermine or disregard content by youth, which may be especially problematic for youth from already marginalized groups. If we are advocating youth to become active in communicating on climate change on social media, we must also consider how to protect them from "trolling", through practical efforts like how to block or otherwise avoid comments, as well as social-emotional skills like building resilience and recognizing the motivations and lacks within social media "trolls." Finally, there is concern that a focus on social media may lead to more shallow engagement (Merritt et al, 2022), and reduce grassroots activism due to increased feelings of fulfillment in their passive activism of liking and sharing content (Yankah et al., 2017).

A major limitation of this review is that it is centered on areas of emerging research, which is why the scoping review format was chosen. There is not currently enough research on many of the topics discussed in this literature review to be able to synthesize clear evidence-based guidelines. We need to better understand the effects of adolescent development on communication needs, positive risk-taking, and both the short and long-term effects of activism. Additionally, much of the research is based on self-reports of intentions, which may be prone to biases and inaccuracies from actual behaviors, and many of the behaviors asked about were

individual rather than collective actions, so they may not adequately reflect whether climate communication or CCE is achieving the true desired aims of mobilizing the populace to meet the collective action needs to avert the worst effects of the climate crisis. A strength of this review was its cross-disciplinary nature and developmental lens to contextualize climate communication within a better understanding of adolescents needs. Of note, most of the research located was in education or environmental science journals. This is an area of opportunity for public health professionals, so we can better understand the public health implications of interventions, or the lack of, in this realm.

Next steps should include looking at whether activism can meet sensation-seeking needs, and, if so, determine if there a correlation to decreased negative risk-taking. There is a need for longitudinal studies, both to see what long-term effects these interventions may have on activism and civic engagement, but also the effects activism may have on long-term mental health. Further work in this space should consider a more nuanced exploration of the experiences of young people across different age categories and developmental stages, and how these experiences vary across different cultures and contexts. A question for future research is whether children starting out with less pro-environmental attitudes would experience similar psychological outcomes to those indicated in the present research, and, if not, what adjustments need to be made to facilitate those gains. Additionally, we need to know how to help transfer online youth engagement to grassroots & in-person activism. To this end, practice and policy initiatives should be enacted to support interdisciplinary and transformative learning that honors youths' need for agency and a voice on a subject that will have such significant and lasting effects on their lives.

Conclusion

Youth are powerful, and that power should be focused to help ensure their own healthy future. The development of tailored interventions that capture adolescents' developmental needs is key to effectively communicating the seriousness of climate change and mobilizing

youth to help our society take the immediate actions needed to limit its effects. In our current climate of the politicization of the facts around climate change, interventions that facilitate transformational learning may be the missing key. Interdisciplinary cooperation, both inside and outside of traditional classrooms, is a challenge that needs administrative, political, and practical support to allow it to happen, along with educators' openness to doing things in new ways. Recent research in adolescent development has highlighted how critical interventions in this life stage can be to long-term health, well-being, and civic engagement. But more research is needed to determine how best to support youth in climate change activism, and to better understand what motivates them. By drawing on behavioral and educational theories such as EPPM and TLT, as well as sound communication theories, the public health and educator community can engage youth to be successful climate communicators now and in the future. A strengths-based perspective should be taken to focus on ways adolescents can challenge themselves in this realm. Particularly for those youth already facing marginalization, every effort should be made to support their agency while also taking steps to build resiliency and protect their mental health.

References

- Action for the Climate Emergency (ACE). 2022. <https://acespace.org/>. Accessed July 18, 2022.
- Action for the Climate Emergency (ACE). 2017. THE POWER OF CONVERSATION Training Youth to Lead Climate Conversations with Parents
- Allen, B & Waterman, W. (2019). Stages of Adolescence. *American Academy of Pediatrics*. <https://www.healthychildren.org/English/ages-stages/teen/Pages/Stages-of-Adolescence.aspx>
- Baker, K. D., Den, M. L., Graham, B. M., & Richardson, R. (2014). A window of vulnerability: Impaired fear extinction in adolescence. *Neurobiology of learning and memory*, 113, 90-100. <https://doi.org/10.1016/j.nlm.2013.10.009>
- Bandura, A., & Cherry, L. (2020). Enlisting the power of youth for climate change. *American psychologist*, 75(7), 945. <http://dx.doi.org/10.1037/amp0000512>
- Basch, C.H., Yalamanchili, B. & Fera, J.(2022). #Climate Change on TikTok: A Content Analysis of Videos. *J Community Health* 47, 163–167. <https://doi.org/10.1007/s10900-021-01031-x>
- Bentz, J. (2020). Learning about climate change in, with and through art. *Climatic Change*, 162(3), 1595-1612.
- Blakemore, S. J. (2018). *Inventing ourselves: The secret life of the teenage brain*. PublicAffairs.
- Bloomfield, E.F., Manktelow, C. (2021). Climate communication and storytelling. *Climatic Change* 167, 34. <https://doi.org/10.1007/s10584-021-03199-6>
- Boulianne, S., Lalancette, M., & Ilkiw, D. (2020). “School Strike 4 Climate”: Social Media and the International Youth Protest on Climate Change. *Media and Communication*, 8 (2), 208-218. <https://doi.org/10.17645/mac.v8i2.2768>
- Busch, K. C., Ardoin, N., Gruehn, D., & Stevenson, K. (2019). Exploring a theoretical model of climate change action for youth. *International Journal of Science Education*, 41(17), 2389-2409. <https://doi.org/10.1080/09500693.2019.1680903>
- Chalupka, S., Anderko, L., & Penne, E. (2020). Climate change, climate justice, and children’s mental health: A generation of risk? *Environmental Justice*, 13(1). <https://doi.org/10.1089/env.2019.0034>
- Chein, J., Albert, D., O’Brien, L., Uckert, K., & Steinberg, L. (2011). Peers increase adolescent risk taking by enhancing activity in the brain’s reward circuitry. *Developmental Science*. <https://doi.org/10.1111/j.1467-7687.2010.01035.x>
- Clayton, S., Manning, C. M., Krygsman, K., & Speiser, M. (2017). *Mental Health and Our Changing Climate: Impacts, Implications, and Guidance*. Washington, D.C.: American Psychological Association, and ecoAmerica.
- Coffey, Y., Bhullar, N., Durkin, J., Islam, M. S., & Usher, K. (2021). Understanding Eco-anxiety: A Systematic Scoping Review of Current Literature and Identified Knowledge Gaps. *The Journal of Climate Change and Health*. <https://doi.org/10.1016/j.joclim.2021.100047>
- Cox, R. S., Hill, T. T., Plush, T., Heykoop, C., & Tremblay, C. (2019). More than a checkbox: engaging youth in disaster risk reduction and resilience in Canada. *Natural Hazards*, 98(1), 213-227.
- Dou, R., Hazari, Z., Dabney, K., Sonnert, G., & Sadler, P. (2019). Early informal STEM experiences and STEM identity: The importance of talking science. *Science Education*, 103(3), 623–637. <https://doi.org/10.1002/sci.21499>
- Duell, N., & Steinberg, L. (2019). Positive risk taking in adolescence. *Child Development Perspectives*, 13, 48–52. <https://doi.org/10.1111/cdep.12310>.

- Duell, N., & Steinberg, L. (2020). Differential correlates of positive and negative risk taking in adolescence. *Journal of youth and adolescence*, 49(6), 1162-1178.
<https://doi.org/10.1007/s10964-020-01237-7>
- Duell, N., & Steinberg, L. (2021). Adolescents take positive risks, too. *Developmental Review*, 62, 100984. <https://doi.org/10.1016/j.dr.2021.100984>
- Environmental Justice Coalition (EJC). 2022. <https://environmentaljusticecoalition.org/>. Accessed July 18, 2022.
- Erickson, E.H. (1968). *Identity: Youth and crisis*. New York, NY: Norton.
- Fryt, J., Szczygieł, M., & Duell, N. (2021). Positive and negative risk taking in adolescence: Age patterns and relations to social environment. *New directions for child and adolescent development*, 2021(179), 127-146.
- Gatersleben, B., Murtagh, N., & Abrahamse, W. (2014). Values, identity and pro-environmental behaviour. *Contemporary Social Science*, 9(4), 374-392.
<https://doi.org/10.1080/21582041.2012.682086>
- Giustini D, Ali SM, Fraser M, Kamel Boulos MN. Effective uses of social media in public health and medicine: a systematic review of systematic reviews. *Online J Public Health Inform*. 2018 Sep 21;10(2):e215. doi: 10.5210/ojphi.v10i2.8270. PMID: 30349633; PMCID: PMC6194097.
- Hayhoe, K. (2021). *Saving us: A climate scientist's case for hope and healing in a divided world*. Simon and Schuster.
- Hickman, Caroline.(2021, September 19). Study Shows Young People Have A Lot Of Anxiety Around Climate Change. *NPR Weekend Edition*.
<https://www.npr.org/2021/09/19/1038681730/study-shows-young-people-have-a-lot-of-anxiety-around-climate-change>
- Hickman, C. (2020). We need to (find a way to) talk about ... Eco-anxiety. *Journal of Social Work Practice*, 34(4), 411-424. <https://doi.org/10.1080/02650533.2020.1844166>
- Hill, C., Corbett, C., St. Rose, A. (2010). Why So Few? Women in Science, Technology, Engineering, and Mathematics. AAUW. <https://www.aauw.org/app/uploads/2020/03/why-so-few-research.pdf>
- Hornsey, M. J., Harris, E. A., Bain, P. G. & Fielding, K. S. (2016). Meta-analyses of the determinants and outcomes of belief in climate change. *Nat. Clim. Change* 6, 622–626.
- Jacobson, S. K., Seavey, J. R., & Mueller, R. C. (2016). Integrated science and art education for creative climate change communication. *Ecology and Society*, 21(3).
- Jensen, F., & Nutt, A. (2015). *The Teenage Brain: A Neuroscientist's Survival Guide to Raising Adolescents and Young Adults*. HarperCollins.
- Johnson, D. C., & Casey, B. J. (2015). Extinction during memory reconsolidation blocks recovery of fear in adolescents. *Scientific Reports*, 5(1), 1-5.
- Kahan, D. M., Peters, E., Wittlin, M., Slovic, P., Ouellette, L. L., Braman, D., & Mandel, G. (2012). The polarizing impact of science literacy and numeracy on perceived climate change risks. *Nature climate change*, 2(10), 732-735.
- Kaplan, S., & Guskin, E. (2019, September 16,). Most American teens are frightened by climate change, poll finds, and about 1 in 4 are taking action. *Washington Post*
https://www.washingtonpost.com/science/most-american-teens-are-frightened-by-climate-change-poll-finds-and-about-1-in-4-are-taking-action/2019/09/15/1936da1c-d639-11e9-9610-fb56c5522e1c_story.html

- Kollmuss, A., & Agyeman, J. (2002). Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior?. *Environmental education research*, 8(3), 239-260. <https://doi.org/10.1080/13504620220145401>
- Kowasch, M., Cruz, J. P., Reis, P., Gericke, N., & Kicker, K. (2021). Climate youth activism initiatives: Motivations and aims, and the potential to integrate climate activism into ESD and transformative learning. *Sustainability*, 13(21), 11581.
- Kranz, J., Schwichow, M., Breitenmoser, P., & Niebert, K. (2022). The (Un) political perspective on climate change in education—A systematic review. *Sustainability*, 14(7), 4194. <https://doi.org/10.3390/su14074194>
- Krauss, S. M., Pittman, K. J., & Johnson, C. (2016, March). Ready by Design: The Science (and Art) of Youth Readiness. In *Forum for Youth Investment*. Forum for Youth Investment. The Cady-Lee House, 7064 Eastern Avenue NW, Washington, DC 20012-2031. <https://forumfyi.org/knowledge-center/ready-by-design-the-science-and-art-of-youth-readiness/>
- Lawson, D. F., Stevenson, K. T., Peterson, M. N., Carrier, S. J., Strnad, R., & Seekamp, E. (2018). Intergenerational learning: are children key in spurring climate action?. *Global Environmental Change*, 53, 204-208.
- Lawson, D. F., Stevenson, K. T., Peterson, M. N., Carrier, S. J., L Strnad, R., & Seekamp, E. (2019). Children can foster climate change concern among their parents. *Nature Climate Change*, 9(6), 458-462.
- Lynas, M., Houlton, B. Z., & Perry, S. (2021). Greater than 99% consensus on human caused climate change in the peer-reviewed scientific literature. *Environmental Research Letters*, 16(11), 114005.
- Maibach, E. (2017) Increasing public awareness and facilitating behavior change: Two guiding heuristics. In L. Hannah and T. Lovejoy (eds.) *Climate Change and Biodiversity*, 2nd edition. Yale University Press. <https://www.climatechangecommunication.org/wp-content/uploads/2018/06/Maibach-Two-heuristics-September-2015-revised.pdf>
- Marlon, J. R., Wang, X., Mildenerger, M., Bergquist, P., Swain, S., Hayhoe, K., ... & Leiserowitz, A. (2021). Hot dry days increase perceived experience with global warming. *Global Environmental Change*, 68, 102247.
- McCright, A. M. & Dunlap, R. E. (2011). Cool dudes: the denial of climate change among conservative white males in the United States. *Global Environmental Change*, 21, 1163–1172. <https://doi.org/10.1016/j.gloenvcha.2011.06.003>
- McGinnis, Breslyn, McDonald, Hestness. (2013). Climate Change in the Next Generation Science Standards (K-12). Climate Change Learning Sciences Research Team at the University of Maryland. <https://www.climateedresearch.org/publications/index.html>
- Merritt, E. G., Stern, M. J., Powell, R. B., & Frensey, B. T. (2022). A systematic literature review to identify evidence-based principles to improve online environmental education. *Environmental Education Research*, 28(5), 674-694. <https://doi.org/10.1080/13504622.2022.2032610>
- Mezirow, J. (2008). An overview on transformative learning. *Lifelong learning*, 40-54.
- Monroe, M. C., Plate, R. R., Oxarart, A., Bowers, A., & Chaves, W. A. (2019). Identifying effective climate change education strategies: A systematic review of the research. *Environmental Education Research*, 25(6), 791-812. <https://doi.org/10.1080/13504622.2017.1360842>
- Moser, S. C., & Dilling, L. (2007). Toward the social tipping point: Creating a climate for change. *Creating a climate for change: Communicating climate change and facilitating social change*, 491-516.

- Naar, S., & Suarez, M. (2021). *Motivational interviewing with adolescents and young adults*. Guilford Publications.
- National Academies of Sciences, Engineering, and Medicine (NAP). 2020. Flourishing in Adolescence: A Virtual Workshop: Proceedings of a Workshop. Washington, DC: The National Academies Press. <https://doi.org/10.17226/25940>.
- National Academies of Sciences, Engineering, and Medicine (NAP). (2020). Promoting positive adolescent health behaviors and outcomes: Thriving in the 21st century. National Academies Press.
- National Science Teaching Association, N. S. T. A. (n.d.). *About the next generation science standards*. NGSS@NSTA. Retrieved August 8, 2022, from <https://ngss.nsta.org/About.aspx>
- Nisbet, M. C. (2009). Communicating climate change: Why frames matter for public engagement. *Environment: Science and policy for sustainable development*, 51(2), 12-23.
- Ojala, M. (2012). Hope and climate change: the importance of hope for environmental engagement among young people. *Environmental Education Research*, 18(5), 625–642. <https://doi.org/10.1080/13504622.2011.637157>
- Olsson, D., Gericke, N., & Boeve-de Pauw, J. (2022). The effectiveness of education for sustainable development revisited—a longitudinal study on secondary students’ action competence for sustainability. *Environmental Education Research*, 28(3), 405-429. <https://doi.org/10.1080/13504622.2022.2033170>
- Park, C. S., Liu, Q., & Kaye, B. K. (2021). Analysis of Ageism, Sexism, and Ableism in User Comments on YouTube Videos About Climate Activist Greta Thunberg. *Social Media+ Society*, 7(3), 20563051211036059.
- Parry, S., McCarthy, S. R., & Clark, J. (2022). Young people's engagement with climate change issues through digital media - a content analysis. *Child and Adolescent Mental Health*, 27. No. 1. p. 30-38. <https://doi.org/10.1111/camh.12532>
- Patnaik, A., Son, J., Feng, A. & Ade, C. (2020). Racial Disparities and Climate Change. PSCI. <https://psci.princeton.edu/tips/2020/8/15/racial-disparities-and-climate-change>
- Plutzer, E., Hannah, A. L., Rosenau, J., McCaffrey, M. S., Berbeco, M., Reid, A. H.. (2016). Mixed Messages: How Climate is Taught in America’s Schools. Oakland, CA: National Center for Science Education. <http://ncse.com/files/MixedMessages.pdf>
- Popova, L. (2012). The extended parallel process model: Illuminating the gaps in research. *Health Education & Behavior*, 39(4), 455-473.
- Rideout, V., Peebles, A., Mann, S., & Robb, M. B. (2022). Common Sense census: Media use by tweens and teens, 2021. San Francisco, CA: Common Sense. https://www.common sense media.org/sites/default/files/research/report/8-18-census-integrated-report-final-web_0.pdf
- Rooney-Varga, J. N., Brisk, A. A., Adams, E., Shuldman, M., & Rath, K. (2014). Student media production to meet challenges in climate change science education. *Journal of Geoscience Education*, 62(4), 598-608. <https://doi.org/10.5408/13-050.1>
- Roosen, L. J., Klöckner, C. A., & Swim, J. K. (2018). Visual art as a way to communicate climate change: a psychological perspective on climate change–related art. *World Art*, 8(1), 85-110. <https://doi.org/10.1080/21500894.2017.1375002>
- Rousell, D., & 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. *Children's Geographies*, 18(2), 191-208. <https://doi.org/10.1080/14733285.2019.1614532>

- Sass, W., Boeve-de Pauw, J., Olsson, D., Gericke, N., De Maeyer, S., & Van Petegem, P. (2020). Redefining action competence: The case of sustainable development. *The Journal of Environmental Education*, 51(4), 292-305. <https://doi.org/10.1080/00958964.2020.1765132>
- Sass, W., De Maeyer, S., Boeve-de Pauw, J., & Van Petegem, P. (2022). Honing action competence in sustainable development: what happens in classrooms matters. *Environment, Development and Sustainability*, 1-22. <https://doi.org/10.1007/s10668-022-02195-9>
- Schwartz, S. J., Luyckx, K., & Vignoles, V. L. (Eds.). (2011). *Handbook of identity theory and research*. Springer Science & Business Media.
- Smetana, J. G., Campione-Barr, N., & Metzger, A. (2006). Adolescent development in interpersonal and societal contexts. *Annual review of psychology*, 57, 255. <https://doi.org/10.1146/annurev.psych.57.102904.190124>
- Stanley, S. K., Hogg, T.L., Leviston, Z., & Walker, I. (2021). From anger to action: Differential impacts of eco-anxiety, eco-depression, and eco-anger on climate action and wellbeing. *The Journal of Climate Change and Health*. <https://doi.org/10.1016/j.joclim.2021.100003>
- Trott, C. D. (2019). Reshaping our world: Collaborating with children for community-based climate change action. *Action Research*, 17(1), 42-62. <http://dx.doi.org/10.1177/1476750319829209>
- Trott, C. D. (2022). Climate change education for transformation: Exploring the affective and attitudinal dimensions of children's learning and action. *Environmental Education Research*, 28(7), 1023-1042. <https://doi.org/10.1080/13504622.2021.2007223>
- U.S. Department of Health and Human Services. (2021, September 14). *Adolescent Health*. Healthy People 2020. https://www.healthypeople.gov/2020/topics-objectives/topic/Adolescent-Health#_edn23.
- Verplanken, B., Marks, E., & Dobromir, A. I. (2020). On the nature of eco-anxiety: How constructive or unconstructive is habitual worry about global warming? *Journal of Environmental Psychology*, 72, [101528]. <https://doi.org/10.1016/j.jenvp.2020.101528>
- Witte, K. (1992). Putting the fear back into fear appeals: The extended parallel process model. *Communication Monographs*, 59(4), 329-349. <https://doi.org/10.1080/03637759209376276>
- Yale Program on Climate Change Communication (YPCCC). (2022, February 23). Yale climate opinion maps 2021. Yale Program on Climate Change Communication. Retrieved July 20, 2022, from <https://climatecommunication.yale.edu/visualizations-data/ycom-us/>
- Yankah, S., Adams, K.S., Grimes, L.E., & Price, A.M. (2017). Age and Online Social Media Behavior in Prediction of Social Activism Orientation. *Social media and society*, 6, 56-89.
- Young Voices for the Planet. (n.d.). Retrieved July 15, 2022, from <https://www.youngvoicesfortheplanet.com/>

Appendix A

Guidelines to Help Youth Develop Climate Activism Messaging

1. Two good options are to “Keep it Short & Sweet” OR “Tell a story”
 - a. don’t be afraid to use pictures or graphics
 - i. A picture says a thousand words!
2. Give the most important information first
 - a. Why is action important
 - b. What actions to take
3. Be authentic & yourself
 - a. Why does it matter to you?
 - b. What are your feelings (might help others not feel alone)?
 - c. What have you done/are trying to do?
 - i. Struggles you’ve had?
 1. Offer solutions that have helped you, or ask for help!
4. Use familiar language, or simply define potentially unfamiliar terms
5. Use an “Active Voice”
 - a. (“I/You/We” do “call to action”)
6. Give solutions/hope
 - a. Especially if what you’ve already shared my cause “fear”/concern/stress (such as explaining how serious climate change is, or tis health impacts!)
 - b. Concrete examples of what they can do today/this week/etc.
7. Respect your audience
 - a. Don’t blame →empower!
8. If using numbers/statistics, try to frame it in way that’s familiar to most people
 - a. for example, rather than saying “68% of people”, can frame as “more than 2 out of 3 people”
 - b. it’s always good practice to share your source for any facts or numbers!
9. If you’re using digital media, give your audience links/sources to where they can get more info, take action, or both!

Here are a few suggestions to get you started:

 - a. <https://acespace.org/>
 - b. Citizen Science opportunities
 - i. <https://www.citizenscience.gov/#> (!!!!)
 1. projects have ranged from helping to map heat islands in major cities, to playing video games to help train AI to recognize different parts of marine ecosystems, to gathering and sending in dragonfly larvae
 - ii. BudBurst
 - iii. FeederWatch

Appendix B

CEPH Foundational Competencies

Competency	For the 1-2 foundational competencies chosen, briefly note why you feel it is relevant to your ILEX paper or presentation. (Note: all students can choose Competency #19, and mention the particular audience)
Evidence-based Approaches to Public Health	
1. Apply epidemiological methods to the breadth of settings and situations in public health practice	
2. Select quantitative and qualitative data collection methods appropriate for a given public health context	
3. Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming and software as appropriate	
4. Interpret results of data analysis for public health research, policy and practice	Literature review to look at known issues related to youth well-being, climate change, eco-anxiety, and activism, and identify areas for additional research
Public Health & Health Care Systems	
5. Compare the organization, structure and function of health care, public health and regulatory systems across national and international settings	
6. Discuss the means by which structural bias, social inequities and racism undermine health and create challenges to achieving health equity at organizational, community and societal levels	
Planning & Management to Promote Health	
7. Assess population needs, assets and capacities that affect communities' health	Literature review to look at known & unknown issues related to youth well-being, climate change, eco-anxiety, and activism
8. Apply awareness of cultural values and practices to the design or implementation of public health policies or programs	
9. Design a population-based policy, program, project or intervention	
10. Explain basic principles and tools of budget and resource management	
11. Select methods to evaluate public health programs	
Policy in Public Health	

12. Discuss multiple dimensions of the policy-making process, including the roles of ethics and evidence	
13. Propose strategies to identify stakeholders and build coalitions and partnerships for influencing public health outcomes	
14. Advocate for political, social and economic policies and programs that will improve health in diverse populations	
15. Evaluate policies for their impact on public health and health equity	Component of literature review
Leadership	
16. Apply principles of leadership, governance and management, which include creating a vision, empowering others, fostering collaboration and guiding decision making	
17. Apply negotiation and mediation skills to address organizational or community challenges	
Communication	
18. Select communication strategies for different audiences and sectors	
19. Communicate audience-appropriate public health content, both in writing and through oral presentation	**ILEX paper/presentation**
20. Describe the importance of cultural competence in communicating public health content	
Interprofessional Practice*	
21. Perform effectively on interprofessional teams	
Systems Thinking	
22. Apply systems thinking tools to a public health issue	Component of literature review

MPH – Behavioral Health Competencies

Competency	For BH concentrators, choose 1 competency you plan to draw on, and mention how it is relevant.
1. Plan a health education training, curriculum, or workshop including stakeholder identification, resource planning and timeline, volunteer recruitment and marketing, strategy selection, and monitoring process.	
2. Effectively deliver evidence-based health education and behavior change intervention skills such as motivational interviewing, health coaching, peer education, mindfulness, or social media messages to individuals or groups.	

<p>3. Analyze the impact of chronic conditions and propose strategies to address prevention and management across all levels of the Socioecological Model.</p>	<p>Effect of eco-anxiety/activism on youth well-being, recommendations from literature review on how to best serve this population</p>
<p>4. Formulate strategies for mental health and substance abuse prevention and treatment in community settings.</p>	<p>Recommendations for communication to youth on climate change and support of activism to address mental health concerns related to climate change</p>
<p>5. Develop a data collection and analysis plan including measures and methods for research on behavioral health.</p>	