

Exploring Educational Values of Deliberative Pedagogy as a Means of Climate
Change Communication

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by
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The undersigned, appointed by the dean of the Graduate School, have examined
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Exploring Educational Values of Deliberative Pedagogy as a Means of Climate
Change Communication
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Exploring Educational Values of Deliberative Pedagogy as a Means of Climate Change Communication

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ABSTRACT

Climate change is a major obstacle facing the world today, impacting the environment and communities across the globe. With rising greenhouse gas emissions and subsequent rising surface temperatures, evidence shows that humans are the culprit. Ninety-seven percent of scientists agree that a global disaster is eminent if there are no changes (Cook et. al., 2016). Strategic action is needed to respond to climate change, and education and effective communication could be imperative to increasing public awareness and better decision-making.

One tool used to increase education and communication is public forums. Public forums allow for deliberative public dialog, or deliberation, which provides individuals the opportunity to come together, discuss, and work through complex issues in an open format. According to recent studies, deliberation is an effective means of exploring issues and ultimately leading to potential solutions. Deliberation delivers new ideas and perspectives to individuals, and can help deepen general understanding of climate change. The effects of climate change are felt most by those not included in the conversation.

This study evaluated the effectiveness of deliberative pedagogy as a means of climate change education by using a quasi-experimental design. The study involved 18 high school students. We hypothesized that deliberation

through environmental issue forums (EIF) would promote knowledge, awareness, hope, and trust regarding climate change, leading to action and solutions.

Program effectiveness was measured using pre-and post-test instruments.

Results of the study suggest that deliberation as a means of education and communication can be an effective way to engage high school students with climate change. There was significant data indicating that knowledge, awareness, and hope regarding climate change increased after individuals participated in deliberation and the forum. These findings lead to recommendations of deliberation research that should consider examining wider demographics and various diverse, youth populations.

I. Introduction

“After participating in the forum, I realized that there is more we can do to stop climate change. And I want to.”

Background

Climate science investigates the dynamics of earth’s climate system, and has provided sufficient evidence of planet warming and changing weather patterns, known today as climate change (IPCC, 2019). The last 5 years have been the hottest ever recorded (Borunda, 2019), with confirmation of this past decade being the warmest as well, according to the National Metrological Service for the United Kingdom. Scientists around the world have published findings of changes in surface, atmospheric, and oceanic temperatures; melting glaciers; diminishing snow cover; shrinking sea ice; rising sea levels; ocean acidification; and increasing atmospheric water vapor (Climate Science Special Report, 2017). More specifically, there is evidence that ocean heat content has increased, with sea levels projected to rise by 4 to 6 feet by the year 2100 (Romm, 2018). Extreme weather such as heat waves of longer duration and higher intensity and frequency have been observed, along with and shorter winters.

Climate change is having devastating effects on the environment, but its impact reaches far beyond. It is more than a problem concerning only the environment, as it is a phenomenon that threatens many facets of life today. Public health, modern economics, and national security are at critical risk from climate change. According to the Center for Disease Control and Prevention

(CDC), climate change impacts on human health are vast, and will intensify over time. The CDC has issued a report describing such issues. Impacts include cardiovascular and respiratory disease, injuries and fatalities caused from extreme weather, change in food availability and distribution, an increase of water-borne illnesses and other diseases, and issues of mental health. Climate scientists and economists from The World Bank have analyzed the climate situation as well, detailing potential economic threats. In low to middle developing nations, natural disasters that result from climate change cost the world around \$18 billion dollars in energy production damage. They estimate a cost of \$390 billion a year on the households effected by these disasters. Climate change has and will continue to affect national security on a regional and international level. The World-Wide Threat Assessment of the US Intelligence Community highlighted military infrastructure and operational issues as a direct result of climate change. Due to “slow-onset climate change impacts,” as many as 140 million climate migrants across sub-Saharan African, southern Asia, and Latin America will be displaced by the effects of climate change by the year 2050.

One of the challenges of effective climate science communication (CCC) today lies in a lack of concrete certainty and a lack of immediacy of climate change when compared to other issues (Moser, 2010). More recently, Ballantyne (2016) has blamed the “wicked issue” on being too complex by nature to offer any obvious solution. While admitting recent increased public awareness of climate change, Wibeck (2014) points to scientific literacy as the main barrier to CCC as well as social norms and cultural factors, i.e. media. Asplund (2018)

draws on this conclusion as one of the biggest issues of CCC-the transition from knowledge to action. Moser (2010) also calls for a greater widespread understanding of the causes of climate change and the stakes involved. While awareness may increase, science still acknowledges the gap between awareness and actual action.

It is known that knowledge does not always lead to action, or that a knowledge-action gap exists (Knutti, 2019). This is described in literature as the knowledge deficit model (Bak, 2001), and is further confirmed by Gardner and Stern (2008) as climate change knowledge does not necessarily result in increased pro-environmental behavior. The answer to the issue of knowledge deficit is not “one size fits all,” but this gap may begin to shrink beginning with effective communication. Information is a powerful tool, but information alone cannot create action. Social support and peer pressure are more likely to influence beliefs compared to solely information and thus, create behavior change (Downing & Ballantyne, 2007). In pursuing action, the first step may lie in deliberative democracy pedagogy (DDP). According to Shaffer et al. 2017, DDP is the sharing of information and knowledge, with attention given to personal narratives and perspectives which allows participants to consider new elements of issues. DDP implies dialog, a crucial part of effective communication according to Moser and Dilling (2011). Dialog involves a shared understanding and learning of problems and potential solutions. The authors describe how important it is that the audience become the first concern, thereby avoiding the typical one-way preaching of scientists “at” the listeners.

Research involving society's view of climate change exists, but the youth perspective of climate change is often overlooked. More young people should be included in the conversation on climate change (Ojala, 2017) because of the importance for a future sustainable society, of which today's youth will one day play a large role. Youth, as it pertains to this study, includes persons between the ages of 14 and 18. Of the literature that exists on youth and climate change, most is concerned with perceptions of and attitudes toward the issue (Leppänen et al. 2012; Ojala, 2015; Wray-Lake, Flanagan, & Osgood, 2009;), with limited literature concerning youth ideas for mitigation and strategy. Youth understand they are a key part of society, as current and future citizens, as they have responsibility in taking action against climate change (Fisher, 2015). Involving youth in the conversation is important for climate science communication and will largely benefit the sustainable development movement.

One very important sustainable development project of today is the 2030 Agenda for Sustainable Development. The Agenda names 17 goals set forth by United Nations members in 2015 to improve certain aspects of life, i.e. climate action, sustainable communities, and quality education, all through a global partnership ("Sustainable Development Goals"). In order to achieve these goals, active participation of citizens, universities, and governments is necessary to move toward a climate-friendly, socially resilient and economically viable society. These goals must be discussed and incorporated into climate change discussions everywhere.

II. Literature Review

Climate Change Communication Challenges

Climate change has been described as one of the most pressing issues facing society today, and has been considered a global threat (Stern, 2007). While climate change has been sufficiently established, evidence has shown that knowledge alone does not necessarily lead to action (Solomon, 2007). Pro-environmental behavior and climate change attitudes have been previously studied in some capacity. It is also worth mentioning that youth have been underrepresented in climate change communication literature, as many of these studies and environmental communication have focused on adults (Balasubramanyam et al., 2019; Boussalis et al., 2018; Carbaugh & Cerulli, 2013). Scientists can address the issues surrounding this knowledge-action gap by means of climate change communication (CCC). Communicating climate science begets many challenges, the issues of which are defined as follows:

Lack of Immediacy: When compared to other issues, climate change may not be prioritized at the top of society's collective list of concerns. For many, the issues resulting from climate change seem distant or irrelevant. Stern (2007) cites that many are too far removed from climate change's direct effects to see the real harm or its potential consequences. Audiences tend to prioritize immediate threats as more relevant and urgent when compared to future issues (Slovik, 2000; Weber, 2006). American citizens classify climate change as a relatively low priority, according to polls conducted by the Pew Research Center. The majority of participants found other policy issues such as much more

pressing. Because many of climate change's effects will not be felt immediately, there is a sense of false security. In an interview by Ailsa Chang with National Public Radio, Brian Gilbert compares the lack of immediacy of climate change to people having trouble flossing: a person will not see dental problems until much later. Gilbert compares this to the slow and imminent flooding of Miami, Florida: People would be outraged if Miami flooded overnight, but people ignore an additional inch of water each year. "They – we become habituated to almost anything." By the time these issues woefully surface, climate change will be irreversible. Research has found evidence that individuals most susceptible to climate change are the least equipped to handle its effects (Crawford et al. 2015).

Message framing: Effective climate change communication can largely depend on the message framing that is used. Chaiken and Trope (1999) argue that the human brain contains two processing systems: analytical and experiential. The analytical processing system controls science information analysis, while the experiential processing system controls survival behavior and emotions. Much of today's climate change communication appeals to the analytical processing system, which does not motivate action in the same way. A personal story or anecdote can be far more effective than statistical evidence. While climate change knowledge is important, data has shown that it alone does not increase public concern of climate change, and therefore will not significantly affect environmental behaviors (Kahan et al., 2012). Other data has revealed that action-related knowledge can be a good predictor of climate change behavior.

Action-related knowledge includes statements containing both a problem and the solution. For example, Shi et al. (2015) assessed climate change public perception by including knowledge-action items such as “turning off the power of electric appliances when they are not in use can save a lot of energy.” Action-related knowledge was positively related with respondents’ concern of climate change and willingness to change to pro-environmental behaviors. If climate change action and mitigation is the goal, message framing plays an important role in climate change communication. It can increase the public’s willingness to adopt pro-environmental behaviors or even positively accept policy measures (Shi et al., 2015).

Complexity of the issue: Climate change affects every facet of the human system, more than just earth’s weather and ecosystems. It is a large issue affecting public health, the global economy, public policy, and national security. Natalie Mahowald and climate scientists from Cornell attribute the complexity of climate change to its processes or cycles, which rule the natural world: physical, chemical, geological, and biological (Swift, 2019). Mahowald most specifically blames the “biogeochemical” imbalance of carbon sinks and emitters, such as forests and agriculture respectively. These biogeochemical issues affect all of society, and quickly become complex. Scientists cannot look to one, blanket solution. Benito Muller (2002) attributes the complexity of climate change to its need for international cooperation. There exist causal disparities between industrialized and developing regions of the world, who emit five times the amount of carbon into the atmosphere (World Resources Institute). For some,

climate change can feel extremely overwhelming, and can even lead to anxiety. If people do not feel that there is a solution, they will feel powerless, and are more likely to not make pro-environmental decisions (Kollmuss, 2002).

Social/Cultural Norms: It has been well established that observed social behavior and social norms influence observer behaviors (e.g. Cialdini et al., 1990; Milgram, Bickman, & Berkowitz, 1969; Gibbs, 1965; Blake & Davis, 1964). In social situations, people look to other individuals, groups, or situations surrounding them for context-appropriate behavior cues, and of which environmental behavior is no exception (Spartz, et al. 2015). Per Espen Stoknes stresses the importance of the role that social groups play in perceivable climate behaviors, with evidence (Rees & Bamberg, 2014) suggesting that social norms and social networks can be determinants of individual's motivations in relation to engagement pro-environmental behaviors. Nisbett and Wilson (1977) found that individuals have a hard time recognizing why they behave the way that they do. A study by Griskevicius, Cialdini, and Goldstein (2008) observed how New York City subway passengers interacted with a street musician. Their study found that passerby who observed another individual donate money were eight times more likely to contribute money themselves when compared to those who did not see someone donating. This can have large consequences on climate change mitigation behavior. Griskevicius, Cialdini, and Goldstein (2008) concluded that social norms can be highly effective in creating pro-environmental behavior change.

Public Deliberation and Deliberative Forums

Deliberation is an effective strategy in engaging the public in science. According to Bohman (1996), public deliberation is “a dialogical process of exchanging reasons for the purpose of problematic situations that cannot be settled without interpersonal coordination and cooperation” (p. 27). Sometimes referred to as deliberative democracy theory, a term coined by Habermas (1996), deliberation is imperative to any decision-making. It can be an effective tool for discussion and democratic decision making. Deliberative forums allow for people to come together and to discuss, consider, and examine issues in an open format. Matthews (1994, p. 195) argued that participants believe that “if deliberation can happen in one meeting, it can happen in others; that if citizens can claim responsibility and act in one community, they can become the ‘solution’ they are looking for in other communities.” Recently, some studies have found success using deliberation as a means for data collection (Hiratsuka et al., 2020; Hara, 2016; Bergmans et al., 2015). These studies have described deliberation as a tool for effective exploration, often leading to discoveries or even solutions. These studies state that deliberation is not the answer, but it is crucial to the process in finding solutions.

Youth and Hope

Hope has many definitions, but usually incorporates motivational goals and thoughts relating to the future. Hope, as defined by Snyder, Rand, and Sigmon (2001), is the theory that equally emphasizes an individual’s ability to set goals, set strategies to reach those goals, and sustain motivation to achieving those goals. Hope could be the key to action, potentially unlocking a powerful

influence on pro-environmental behavior (Ojala, 2012). Individuals who feel a high sense of hope are more likely to take action (Snyder, 2000). Hopeful individuals also are well-adjusted and able to more efficiently problem solve (Drach-Zahavy and Somech, 2002). Few research exists that explicitly explores levels of hope regarding climate change, and fewer exist that explore the topic among youth. The literature that does exist on the subject today comes mainly from Ojala and Li and Monroe. Ojala (2012 & 2015) has published studies on Swedish youth attitudes and levels of hope regarding climate change and has found that hope is important for environmental engagement leading to action among young people and teenagers in Sweden. Li and Monroe (2017 & 2018) have studied hope regarding climate change, but all agree that more empirical studies are needed.

Civic Engagement

Another climate change communication issue scientists can address is the participation gap. The participation gap, also known as the civic engagement gap, describes the disconnection or separation between certain demographics and participation in society. This paper will consider, among other topics, the youth civic engagement gap.

Civic engagement: Civic engagement is defined as any individual or collective actions designed to address issues of public concern (Battistoni, 2002), and further includes the empowerment of people to reflect on life and to participate in democracy (Læssøe, 2007). Participation in civic engagement heavily relies on three criteria according to Læssøe (2007): motivation, opportunity, and ability to engage. Lacking or neglecting any or all of these three

criteria can attribute significantly to less engagement, affecting some demographics more than others. Citizens who are not registered to vote or do not follow government affairs are civically disengaged, and are categorized as bystanders. According to a profile on political affiliation by the Pew Research Center, 18-29 year olds and 30-49 year olds are most commonly bystanders, reporting rates approaching 40%. They usually experience some type of alienation from the institutions or processes of civic life, and cannot overcome these experiences through motivation, opportunity, or ability. The Harvard Public Opinion Project 2019 youth poll found that 30% of Americans aged 18-29 considered themselves politically engaged while only 20% trusted the federal government. The Close Up Foundation found that 25% of 15-24 year olds believed that government affects their daily lives, while 64% believe that today's political leaders have failed them. These statistics are important because civic engagement habits are formed during these late formative years, which begins the shaping of political ideals and worldviews.

Youth and civic engagement: This century has witnessed a large decline in civic engagement, especially as it pertains to youth. Today's youth are largely disengaged and less involved when compared to youth of past generations (Carpini, 2000). Today's youth: (1) have seen significant decline in trust of their fellow citizens (Rahn, 1998 as cited in Carpini, 2000), (2) have seen a large decline in political interest (Sax et al. 1997), (3) are less informed on news and current events (Zukin, 1997), (4) and are less likely to participate in community organizations (National Association of Secretaries of State, 1998 as cited in

Carpini 2000). Adolescence is an important time in identity formation, therefore it is critical that young people actively participate in their communities (Arnett, 2006). It is important to include youth in the conversation on topics such as climate change because as key stakeholders, they will bear its burdens.

It has been established that youth involvement in civic engagement is critical for a high-functioning society (Children International, 2015). The United Nations recognizes this and therefore hosts the United Nations International Youth Day annually on August 12. Since 1999, this Day has celebrated youth (they define as aged 10-24) as essential partners in change. The campaign promotes youth empowerment through civic engagement in politics and public life, helping them to become contributing members of society. The formative experiences of youth engaging can have lasting individual, societal, systemic, and environmental impacts. According to a study by Arnold et al. (2019) of Family and Community Medicine, the benefits of can include building community, fulfilling social needs, changing policy, and ensuring a healthy democracy. The impact can be transformative, even shattering expectations and ceilings set by society.

Active Learning

Active learning is any instructional method that engages students as active participants in their learning process (Bonwell & Eison, 1991). Where traditional learning methods involve students passively receiving information, active learning requires students to participate, reflect, and get involved in their learning. According to Prince (2004), the benefits of active learning include improved critical thinking skills, increased retention of new knowledge, increased

motivation, better interpersonal skills, and increased course success. When students are involved in the learning process in a hands-on, integrative, and collaborative manner, they are more likely to be successful in school as well as personal development (Kuh, O'Donnell, & Schneider, 2017). The most common active learning activities include writing, talking, problem-solving, and reflecting, which are key elements of deliberation.

Environmental Issues Forums

Environmental Issues forums (EIF) are part of a nationwide network of sponsored public forums that consider local, national, or international public issues. The forums allow for participants to deliberate through the issues and provides them with potential courses of action. NAAEE provides a step-by-step process for forums. The process involves:

- (1) Welcome and introduction: The moderator welcomes the participants and both are encouraged to introduce themselves. Ground rules of respect, anonymity, and honesty are discussed. The EIF Climate Choices booklet is distributed to all participants.
- (2) Pre-survey: A 39 item pre-survey is administered requiring roughly 10 minutes.
- (3) Climate Choices video: A 10-minute video discussing climate change and 3 mitigation options plays, while participants are reminded to pay attention or write notes for the impending discussion.
- (4) Initial reactions: As a warm-up, participants are invited to express their initial reaction to the video, calling upon emotions or thoughts experienced

during the video-in one sentence or less. The facilitator provokes participants to make personal connections.

(5) Three option discussions:

- a. First option discussion: The facilitator begins the discussion of the first option, or *sharply reduce carbon emissions*. The facilitator prompts questions and keeps conversation flowing.
- b. Second option discussion: The facilitator begins the discussion of the second option, or *prepare and protect our community*. The facilitator prompts questions and keeps conversation flowing, directing it and keeping it on topic.
- c. Third option discussion: The facilitator begins the discussion of the third option, or *accelerate innovation*. The facilitator continues to prompt questions in order to keep the conversation flowing.

(6) Closing thoughts: Participants are encouraged to organize thoughts and express any final feelings or beliefs with the group.

(7) Post-survey: A post-survey is administered requiring roughly 15 minutes.

The goal of environmental issues forums and the Climate Choices issue guide is to get people deliberating, and talking through environmental issues. It aims to assist people in moving from initial reactions to more reflective judgment. This requires serious deliberation, or weighing options for action against the things people hold valuable. Participants deliberate and contribute their opinions, experiences, and perspectives, and conversation is created. This is important, as facts alone have shown to do little to change the minds of the public (Owens,

2000), especially on the topic of climate change. EIF utilizes deliberation among non-experts who create their own dialogue.

Trust in science

Trust is defined as accepting vulnerability to others (Baier, 1986), and can refer to scientific authorities and principles as they relate to this paper. Scholars have been studying public levels of trust in science for years, or what is known more specifically as epistemic public trust in science. Epistemic public trust in science describes the conditions in which the public attests to trusting scientists as providers of information (Irzik, 2019). Today, there lies a growing distrust in scientific authority (Aupers, 2012). Trust in science can waver for a variety of reasons, such as when scientists lack transparency, or when media interferes. Hardwig (1991) was one of the first to fully explore the concept of trust in modern science. He argued that trust is more important than empirical data, because the data only becomes available if trust and integrity are present. This has many implications for any scientist trying to publish their work. Huber et al. (2019) explored the role of news in social media and public levels of trust in science. It was found that social media is a great tool for scientists to interact directly with the public, but with some caveats. Fake news and misinformation can disrupt public trust in science. Little research exists today that fully explores youth levels of trust in science, which could be key in closing the trust in science divide.

Significance of the Study

Communication of the complexities of climate science can be a daunting task. The conversation surrounding climate change today is ripe with challenges: it is a complex issue, with no simple solutions; it can be an overwhelming topic,

often accompanied by “doomsday” attitudes; and the effects of climate change often feel far away, or even impersonal. Deliberating through these challenges can help people better cope with climate change and manage their concerns. This study provides a better understanding of deliberative pedagogy as a means of engagement particularly among youth, while exploring the topic of climate change and engagement. Deliberative pedagogy could provide countless benefits to climate change communication.

Literature exists that attempts to explore climate change communication. Notably, Nerlich et al. (2010) published a study looking at the use of language pertaining to climate change and specifically, eco-friendly behavior change. More recently, studies have considered the role that media or celebrities play in climate science communication. Anderson (2011) found that celebrities often enhance possibilities for democratic involvement and can increase engagement surrounding certain issues. Boykoff and Boykoff (2007) found that media and news play a key role in shaping attitudes and perceptions around climate change, even contributing to some behaviors. In a study on climate science communication interfaces, Moser (2016) expressed the need for further research, in order to more effectively engage across supposed “fences,” ie. worldviews and disciplines. These studies and others contribute to climate science communication research, but do not focus on deliberative pedagogy as the crux of their exploration. Deliberative pedagogy is integrative, using deliberative processes to consider issues with a democratic and open mindset, according to Timothy Shaffer (2017). Shaffer argues that the deliberative pedagogy model is

less transactional or one-directional than traditional models of dialog. It was designed as a tool for increasing civic engagement as well as decreasing the knowledge-action gap. This study explores the educational value of deliberative pedagogy specifically as it relates to youth and climate science communication. The findings in this paper compliment the foundational research of active learning (Bonwell & Eison, 1991), or the idea that students participate instead of passively listening, that have become more robust in recent years.

III. Objectives

The objectives of this study were two-fold: (I) explore the educational values of deliberative pedagogy as a means for addressing climate change mitigation and (II) evaluate its effectiveness. Through deliberation of climate change and mitigation strategies, we looked to better understand each of these questions: (i) in utilizing EIF, to what degree does deliberation influence levels of knowledge, awareness, hope and trust concerning climate change? (ii) how strongly does deliberation influence climate change mitigation strategies on an individual scale? (iii) what are the general participant perceptions of EIF and deliberation of youth in Missouri?

IV. Methods

Adaptation of EIF

Environmental Issues Forums is based on the theory of deliberative pedagogy in the community with the notion that democracy requires an ongoing deliberative public dialogue (Longo, 2013). We adapted EIF to better address a youth audience. We did this by referencing the Climate Choices EIF in the Classroom High School Teacher Guide (2016) and EIF Moderator Resources Guide (2016). We adapted and shortened the participant survey form as well.



Figure 1. Deliberative framework for deliberative pedagogy in the community. (Adapted from Climate Choices: How Should We Meet the Challenges of a Warming Planet? – Issue Guide).

According to Longo (2013), deliberative dialogue, community engagement, and democratic education work together in order to create space for conversations that are grounded in real-world experiences. EIF improves upon this model with the addition of a call to action component.

Deliberative dialogue: Deliberative dialogue involves a model for citizens coming together to consider facts and values from different point of views while

listening to others and trying to work through issues in order to better understand and gain perspective (Carcasson, 2013). This helps address large problems in a productive manner.

Community engagement: Community engagement is a process involving groups of people working together who are either affiliated geographically, have shared interests, or share certain situations that affect their well-being (CDC & ATSDR, 2013). With regard to climate change, it is hoped that increased community engagement will lead to citizens becoming more involved in civic planning and decision-making (Nkoana et al., 2018). Research by the Australian Department of Sustainability and Environment (2005) has shown that community participation and engagement in action and decision-making has revealed benefits such as improved policy and program design and higher rates of implementation.

Democratic education: According to Sant (2019), many definitions or versions of democratic education exist, including deliberative democratic education. Democratic education provides space where citizens can discuss, deliberate, and learn in a space of equity (Abowitz & Harnish, 2006) with a focus on educational policy and practice (Hanson & Howe, 2011). Hanson and Howe (2011) further explain the importance of inclusivity: that all perspectives of persons governed by public decisions must be considered. Communication and collaboration are main components of democratic education, with the hope that this education will lead to action.

Environmental Issues Forums: The creation of Environmental Issues Forums was based on the relationships of the terms outlined above. EIF is a tool created by NAAEE to address problems and create solutions, all rooted in deliberative pedagogy. The procedure was borrowed from the NAAEE *Climate Issues* guide and slightly adapted for youth. Surveys were shortened and some advanced language was modified.

Evaluation of EIF

Design

The evaluation of the EIF was quasi-experimental in nature, including a pre-test and post-test (Figure 2). There were 2 groups in the study: a group of youth serving as the pilot test group (spring 2019, St. Louis Science Center) and a second group of youth (summer 2019, University of Missouri summer camp). The groups received treatment in the form of the forum, with resource guidebooks provided from the NAAEE website. The forums lasted approximately 2 hours, with a 10-minute break after the first option discussion. Data was collected before the forum activity and immediately after, for both groups.

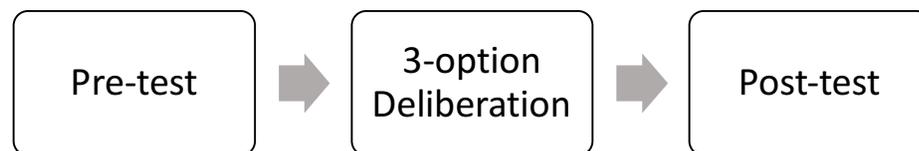


Figure 2. A schematic diagram of the methodological design.

Participants

Two groups of youth participants attended the forum and participated in the study. The first group included high school students from the Youth Exploring Science Program in partner with the Saint Louis Science Center. This is a

yearlong professional development program for urban students that meets on Saturdays. Students are first nominated by the Science Center community partners and then selected for participation in the program. The forum was held in the spring of 2019. The second group included high school students attending the weeklong ‘Natural Resources Careers Academy’ at The University of Missouri through the School of Natural Resources in the summer of 2019. Both groups included participants between the ages of 16-18. 19 students were recruited in total. Historically, both the YES Program and NRCA camp were comprised of participants of the same age group (15-18), with mixed ethnic and social backgrounds, making them good subjects of this research.

Table 1. *Social Demographics of the Participants*

	NRCA Camp (n = 10)		YES Program (n=8)	
	N	%	N	%
Gender				
Male	6	60.00	4	50.00
Female	4	40.00	4	50.00
Non-reported	0	-	0	-
Ethnicity				
Hispanic	0	-	0	-
Non-Hispanic	10	100.00	8	100.00
Race				
White	10	100.00	0	-
African American	0	-	8	100.00

Study site

The YES Program forum took place at the Taylor Community Science Resource Center, a metropolitan, associated branch of the Saint Louis Science Center. This center provides after-school programs, educator professional

development, and community learning activities through education of science and technology (Taylor Community Science Resource Center). It opened in 2003 following a donation by Jack Taylor, a St. Louis native and philanthropist wanting to improve science. The Natural Resources Careers Academy camp was based out of the Agriculture building at the University of Missouri, with daily field trips involving various science activities. The forum took place on the second day of camp, in a classroom in the School of Natural Resources during one of the daily sessions.

Instrument

Pre-and post-tests were administered to the participants in order to assess changes in levels of knowledge, awareness, hope, and trust (see Appendix A). The post-test offered additional questions regarding forum perceptions in general as well as more ideas for climate change mitigation. The pre-test included 22 items, while the post-test included 34 items plus demographic information. A cohort of graduate students in the Human Dimensions of Natural Resources program reviewed both surveys in order to increase validity. The YES Program served as a pilot test. The post-survey was later revised with minor grammatical and structural changes.

Knowledge: Three measures were used to assess levels of knowledge regarding climate change. Participants were questioned on the evidence of climate change as well as the cause, and the concentration of carbon in the atmosphere. Questions for this knowledge section were adapted from a publication by the Yale Program on Climate Change Communication, "American

Teens' Knowledge on Climate Change Communication" by Anthony Leiserowitz et. al. (2011). For the knowledge section, questions were measured using a dichotomous instrument, (0=incorrect; 1=correct) with each student earning a score ranging from 0 to 4 based on their total number of correct responses.

Awareness: Four measures were used to assess levels of participant awareness regarding climate change, with items adapted from Leiserowitz et al. (2011). Participants were asked to report how well informed they felt regarding climate change. Participants responded to statements gauging levels of awareness including (a) *how climate change works*, (b) *different causes of climate change*, (c) *different consequences of climate change*, and (d) *mitigation strategies for climate change on a scale of (1) not at all informed to (4) very well informed*. Scale reliability was tested for and a Cronbach alpha score was determined to be $\alpha=.74$ and $.86$ for the NRCA and YES Program respectively. (Tables 2 & 3).

Hope: The hope scale consisting of five items was adapted from Li and Monroe (2018), with responses measured on a 7-point scale, from (1) *strongly disagree* to (7) *strongly agree*. Participants responded to statements gauging levels of hope including (a) *I am hopeful about resolving climate change because more people are taking climate change seriously*, (b) *I know that there are a number of things I can do to contribute to climate change solutions*, (c) *I am hopeful about climate change because I can think of many ways to solve this problem*, (d) *I am willing to take actions to help solve problems caused by climate change*. Scale reliability was tested for and a Cronbach alpha score was

determined to be $\alpha=.61$ and $.80$ for the NRCA and YES Program respectively. (Tables 2 & 3).

Trust: The trust scale consisted of five items and was adapted from Nadelson et al. (2014). All responses were measured on a 7-point scale, from (1) *strongly disagree* to (7) *strongly agree*. Participants responded to statements gauging levels of trust including (a) *science can help me better understand the world*, (b) *science will help me better understand my effect on the environment*, (c) *I think that society should use scientific methods to make good decisions*, (d) *learning or collecting evidence in science is important and enables us to make good decisions*, and (e) *knowledge of science helps us understand issues such as climate change*. Scale reliability was tested for and a Cronbach alpha score was determined to be $\alpha=.85$ and $.95$ for the NRCA and Yes Program respectively (Tables 2 & 3).

Student perceptions of climate change mitigation strategies: Six items were used on the post-test in order to gauge participant levels of importance regarding climate change mitigation strategies. The responses were measured on a 5-point scale with regards to the various strategies, from (1) *strongly disagree* to (5) *strongly agree*. Participants responded to the mitigation statements (a) *schools should teach children about the causes, consequences, and potential solutions to global warming*, (b) *climate change will cause damaging changes for me and my community in my lifetime*, (c) *since the US is one of the world's largest greenhouse gas producers, it should take the lead in reducing emissions of CO₂*, (d) *encourage Americans to use less energy by*

taxing fossil fuels, EVEN IF this burdens poor Americans by increasing the costs of necessities and commuting to their jobs, (e) ease the rules for bringing new “green” technologies to the market EVEN IF there’s a chance they could harm human health and safety, (f) increase the use of electric vehicles and redirect highway funds to create bike lanes, car-free zones and pedestrian-friendly neighborhoods, EVEN IF these actions will take a long time to produce any significant cuts in carbon emissions. Due to the small sample size, we yielded a Cronbach alpha of $\alpha=.68$ for internal reliability.

Qualitative Data

The forums were recorded, with undergraduate research assistants subsequently transcribing the recordings. The forum utilized a series of open-ended questions that allowed the students to report more, as well as think critically through the deliberation and offer new perspectives or responses. The researcher examined the transcribed data, and quotes were pulled that pertained to themes concerning the measures of knowledge, awareness, hope, and trust. The selected direct quotes from the forum demonstrated elements of the 4 measures, which were reviewed and deductively coded by category. The Climate Choices EIF in the Classroom High School Teacher Guide (2016) and NAAEE Moderator Resource Guide (2016) helped support the moderator in tailoring the questions to the students to ensure relevant themes were considered and captured. After both forums, the researcher took structured notes to summarize the forum atmosphere and context.

Data Analysis

The quantitative data were analyzed using computer program IBM SPSS statistics software version 25. SPSS utilized means, percentages, standard deviations, and frequency distributions to analyze demographic information. SPSS inferential statistics were used to analyze mean comparisons of pre-and-post-tests. Dependent t-tests were used to compare mean levels of knowledge, awareness, hope, and trust regarding climate change before and after the Environmental Issues Forum. A significance level of alpha .1 was used due to the small participant group size.

VI. Results

Knowledge concerning climate change

The results demonstrated there was a significant increase in the students' level of knowledge regarding climate change for the YES Program group ($t = 2.39$, $df = 7$, $p = .05$) from baseline ($M = 2.25$, $SD = 0.89$) to after ($M = 3.00$, $SD = 0.00$) the Environmental Issues Forum (Table 3). For the NRCA group, there was no significant change in the level of knowledge concerning climate change ($t = .150$, $df = 9$, $p = .16$; Table 2).

Awareness concerning climate change

There was a significant increase in the students' awareness concerning climate change for both groups. The NRCA group level of awareness increased from ($t = 3.46$, $df = 9$, $p = 0.01$) from baseline ($M = 11.60$, $SD = 2.01$) to after ($M = 13.60$, $SD = 1.58$) the Environmental Issues Forum (Table 2). The level of awareness of climate change for the YES group increased ($t = 3.85$, $df = 7$, $p = .06$) from a baseline of ($M = 10.13$, $SD = 3.04$) to after ($M = 13.25$, $SD = 1.91$) the Environmental Issues Forum (Table 3).

Hope regarding climate change

There was a significant increase in the students' sense of hope regarding climate change for both groups. The NRCA group level of hope increased from ($t = 3.55$, $df = 9$, $p = .01$) from baseline ($M = 20.80$, $SD = 2.97$) to after ($M = 23.50$, $SD = 2.36$) the Environmental Issues Forum (Table 2). Also, there was found to be significant increase in the level of hope regarding climate change for the YES

group ($t = 3.90$, $df = 7$, $p = .01$) from baseline ($M = 18.38$, $SD = 3.89$) to after ($M = 23.38$, $SD = 4.53$) the Environmental Issues Forum (Table 3).

Trust regarding climate change

There was no significant increase found for the students' level of trust regarding climate change for either group of students; the NRCA group level of trust regarding climate change was found to be ($t = 1.92$, $df = 9$, $p = .07$; Table 2); the YES group level of trust regarding climate change was found to be ($t = 1.04$, $df = 7$, $p = .22$; Table 3).

Table 2. *Effectiveness of EIF Adapted Toolkit (Natural Resources Careers Academy)*

	Pre-test		Post-test		<i>t</i>	<i>Df</i>	<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
Knowledge	2.50	0.71	2.70	0.48	1.50	9	.16
Awareness ($\alpha = .74$)	11.60	2.01	13.60	1.58	3.46	9	.01
Hope ($\alpha = .61$)	20.80	2.97	23.50	2.36	3.55	9	.01
Trust ($\alpha = .85$)	33.10	2.33	33.90	1.37	1.92	9	.07

Table 3. *Effectiveness of EIF Adapted Toolkit (YES Program)*

	Pre-test		Post-test		<i>t</i>	<i>Df</i>	<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
Knowledge	2.25	0.89	3.00	0.00	2.39	7	.05
Awareness ($\alpha = .86$)	10.13	3.04	13.25	1.91	3.85	7	.01
Hope ($\alpha = .80$)	18.38	3.89	23.38	4.53	3.90	7	.01
Trust ($\alpha = .95$)	27.25	6.09	28.25	5.65	1.04	7	.33

Participant perceptions of EIF and climate change mitigation

At the end of the forum, the participants were asked to record their observations of the forum as well their ideas of action for climate change mitigation in the post survey. The participants reported that they were hopeful about resolving climate

change behavior because more people are taking climate change seriously ($M = 5.5$), there are a number of things that they can do to contribute to climate change solutions ($M = 6.2$), they are hopeful about climate change because of the many ways to resolve the problem ($M = 5.5$), they are willing to take actions to help solve the problems caused by climate change ($M = 6.2$), science can help one better understand the world ($M = 6.3$), science can help one better understand their effect on the environment ($M = 6.5$), they think that society should use scientific methods to make good decisions ($M = 5.8$), learning and collecting evidence in science is important and enables us to make good decisions ($M = 6.2$), and that knowledge of science helps us to understand issues such as climate change ($M = 6.5$).

Table 4. *Participants' Perceptions of EIF and Climate Change Mitigation*

Items	<i>M (SD)</i>
Science can help one better understand their effect on the environment	6.56 (1.04)
Knowledge of science helps us to understand issues such as climate change	6.50 (0.86)
Science can help me better understand the world	6.33 (1.14)
I am willing to take actions to help solve climate change issues	6.22 (1.11)
I know there are a number of things that they can do to contribute to climate change solutions	6.22 (0.87)
Learning and collecting evidence in science is important and enables us to make good decisions	6.16 (1.04)
I am hopeful about resolving climate change because more people are taking climate change seriously	5.50 (1.20)
I think that society should use scientific methods to make good decisions	5.50 (1.20)
I am hopeful about climate change because of the many ways to resolve the problem	5.83 (1.20)

Note: scale of one to seven in which one is “strongly disagree” and seven is “strongly agree”.

Student perceptions of climate change mitigation strategies

Six items were used on the post-test in order to gauge participant levels of importance regarding climate change mitigation strategies. The YES group identified most with statement: (c) since the US is one of the world’s largest greenhouse gas producers, it should take the lead in reducing emissions of CO₂, ($M = 4.5, SD = .76$). The YES group least identified with statement (e) ease the rules for bringing new “green” technologies to the market EVEN IF there’s a chance they could harm human health and safety, ($M= 3.5, SD = .76$). The NRCA group most identified most with statement (a) schools should teach children about the causes, consequences, and potential solutions to global warming, ($M = 4.8, SD = .42$). The NRCA group least identified with statement (d) encourage Americans to use less energy by taxing fossil fuels, EVEN IF this burdens poor Americans by increasing the costs of necessities and commuting to their jobs, ($M = 3.7, SD = 1.49$).

Youth Ideas on Climate Change Mitigation Strategies

Students were asked to respond to questions pertaining to their ideas regarding climate change mitigation strategies. They were first asked to respond to the question “In a few sentences, what actions do you think you can **personally** take to lessen and adapt to climate change?” Four main themes emerged from the participants: consumption, civic engagement, education, and technology, and are further explored in *Table 5*.

Table 5. *Qualitative Response Mitigation Strategies*

Categories	Codes	Phrases	Responses ^a by NCRA participants	Responses ^b by YES participants
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Consumption	Humans should reduce consumption	Less single-use plastics	2	1
		Use less water	1	-
		Recycle	1	4
		Less goods	2	-
	Humans should use less energy	Fossil fuel emissions	3	4
		Clean energies like wind or solar	2	-
		Less electricity	2	1
		Sustainable agriculture	3	-
		Invest in nuclear energy	2	-
	Humans should consider their transportation	Electric vehicles/hybrid cars	2	2
		Carpooling	1	1
		Public transportation	2	1
		Walk more	1	1
	Humans should be food-conscience	Consume less meat	1	-
		Eat locally	1	-
		Support farmer's markets	1	-
Humans should be business-conscience	Green businesses/products	4	-	
Civic engagement				

Education	Humans should get involved politically	Vote for green acts	3	-
		Lobby and petition	3	-
		Work together/with communities	2	-
Technology	Humans should teach others	Spread awareness/ educate communities	3	2
		Climate change preparation	Help famers and others prepare for effects	-
	Invest in new technology	Support smarter/efficient technologies	-	1

Qualitative Findings

Participants exhibited a range of beliefs about climate change. The NRCA and YES groups displayed levels of knowledge, awareness, hope and trust regarding climate change through their exchanges throughout the forum.

Knowledge

At the beginning of the forum, one student claimed that they did not know ways that they could reduce their carbon emissions. One student commented, “I don’t think that I do anything myself that could help me reduce carbon emissions.” Many in the group nodded in agreement. Later in the forum though, after some deliberation, that same student offered, “Well, I ride the bus

sometimes. I guess I could unplug my electronics when I am not using them. And I walk to the store sometimes instead of driving.” Another student added: “I remember seeing a commercial that would remind you to turn off the lights when you leave a room. Saving energy.”

The students even used the deliberation time to teach one another on different aspects of climate change. The moderator asked the group, “Does anyone know where electricity comes from?” One student answered: “The sky?” Some students laughed, while another student countered, “Well, not unless you are using solar panels.” The first student guessed again, “Coal? I don’t know.” After confirming that coal was indeed an energy source, the student offered excitedly, “Oh! I was right? Well yeah that makes sense, and the less electricity we use, the more coal we have!”

Awareness

In the middle of the forum, the moderator was asked by the teacher to turn off the projector. A student commented: “See, we are saving energy right there!” Many of the other participants laughed, and smiled in agreement.

Later in the forum, students were asked what stuck out to them the most from the deliberation, and what they found most important for climate change mitigation.

One student responded, “It is almost like a space race for reducing emissions.

Not landing on the moon, but stopping climate change.”

Hope

At the end of the forums, the participants were asked to reflect and then respond to the question “what did you find most significant from today’s forum?”

One student answered, “After participating in the forum, I realized that there is more we can do to stop climate change. And I want to.” Another student added, “Talking about these things as a group helped me see my peers’ perspectives and how what we do can make a difference for our futures, and we can.”

Trust

In the beginning of the forum while explaining how the majority (but not all) of scientists agree climate change is anthropogenic, one participant raised the concern, “If the scientists all agree, then what is the problem? They study it, I trust it.” Many other participants nodded in agreement. There was a general atmosphere of trust in science experienced in both forums.

VII. Discussion

Results suggest that there was a significant increase in levels of awareness and hope for both groups who participated in the forum. There was a significant increase in knowledge for the YES program group, while the NRCA group results showed no significant change. However, levels of trust regarding climate change was not found to be statistically significant for either group.

There was a significant increase in knowledge of climate change for the YES program students. These students were able to identify the causes of climate change as well as evidence of its effects. There was not a significant increase in knowledge of climate change for the NRCA group, which could be explained by differences in their respective school curriculums. Results from this study partially support the research conducted by Leiserowitz et al, 2010 on the Yale Project on Climate Change that addressed climate change knowledge of Americans. The majority of YES program students had heard of climate change before, but did not fully understand it or had not previously studied it. Some of the deliberation was spent explaining the various concepts to participants rather than actual discussion. Throughout the forum, brief definitions and discussion of new terms was offered, with deliberation ensuing. This could explain why some of the data was found to be insignificant. Lack of knowledge is one of the biggest barriers (Shi et al., 2015) to the societal response to climate change, and deliberation can be one of the most effective ways to address this challenge. Thus, deliberation can be an effective tool for increasing knowledge, assuming that prior levels of knowledge do not exist.

There was a significant increase in awareness of climate change for both groups. After participating in the forum, data showed that the students felt informed on personal consequences and implications of climate change in their lives. These results support the deliberation theory (Gastil & Levine, 2001) that deliberation provides benefits for an individual's decision-making process. Carcasson and Sprain (2010) describe a "deliberative democracy movement," and state that deliberation is an invaluable tool for addressing today's largest issues. More specifically, it allows individuals to imagine their roles as problem-solvers, which is a key piece of the climate change conversation. Ultimately, deliberation is an effective means for increasing awareness of issues.

There was a significant increase in levels of hope regarding climate change for both groups. The results of these data are concurrent with Snyder's (2000) hope theory, which states that hopeful individuals are generally more likely to take action. Hayden et al. (2011) explored hope theory in relation to climate change and described hope as essential to tackling environmental issues. The increase in levels of hope regarding climate change suggests that deliberation is a beneficial tool that can increase levels of hope. Hope and action go hand in hand when in context of climate change, according to Bentley et al. (2004).

There was no significant change in levels of trust regarding climate change for either group of students. Trust in science is complex, and levels can be influenced by social, political, or even personal factors. For youth, trust in science and scientists can impact the learning and understanding of science

(Ipsos MORI, 2011). Trust is based on knowledge, emotions, beliefs, and relationships, and can influence engagement (Nadelson et al., 2014). In a 2007 IPCC report, it was found that Americans trusted scientists and scientific organizations more than any other source of information regarding climate change. Our data showed no significant change in levels of trust of science regarding climate change, which could be explained by the relatively high levels of trust in science that were initially reported.

For climate change mitigation strategies, both groups explored ideas for taking action. The students considered various consumption trends, civic engagement involvement, education movements, and technological developments. For consumption trends, both groups discussed the importance of reducing consumption, using less energy, and considering green transportation options. Both groups found these ideas to be essential to climate change mitigation. The NRCA group also identified the importance of food and business consciousness.

For civic engagement, the NRCA group expressed ideas for political involvement, such as the importance of voting. The YES program group did not comment on the importance of political involvement. This could be explained by the political “participation gap” that exists between individuals of high and low socioeconomic status (Schlozman et al., 1999). There is also a rural-urban divide. In a study by Hart and Atkins (2002), it was found that urban youth tend to face more obstacles that inhibit knowledge of community engagement or access

to participation opportunities. These constraints could explain why the YES program group did not explore civic engagement ideas during the forum.

For the topic of education, both groups found it worthy of discussion. Both groups reported the importance of spreading awareness of climate change among communities, as well as educating their communities on potential outcomes and risks associated with climate change. Knowledge of issues is the first step in creating action. Being educated about a subject is an important step in the decision-making process.

This study shows that deliberation as a means of communication of climate change is meaningful. Deliberation can be an effective tool for increasing knowledge, awareness, and hope. Based on this study and previous studies exploring deliberation (Hiratsuka et al., 2020; Hara, 2016; Bergmans et al., 2015), we recommend that organizations, educators, researchers or any present stakeholders utilize deliberation as a means of addressing topical issues and as a means to increase learner efficacy.

VIII. Limitations

Sample size has potentially played a role in the limitations of this study. With small sample size, a researcher runs the risk of findings not fully being extrapolated (Faber & Fonseca, 2014). Participant attendance for the NRCA camp was down by over 60% compared to the summer of 2018, affecting the researcher's anticipated sample size.

Researchers must also be aware of generalizability, or the findings of a sample being applied to the entire population. The use of a small sample size and the inability to measure potential long-term effects are limitations of the study. Further, the use of self-selected convenience sampling could be a limitation of the study. The two sample groups experienced many social and developmental differences. The NRCA participants indicated that they had briefly covered climate change in school, whereas the YES Program participants conveyed that for many of them, this was their first exposure to climate change education, formal or otherwise.

IX. Future Research

Future research should look to incorporate a longitudinal component of the study, looking at potential long-term effects of the forum. Further exploring the lasting effects of deliberation, such as willingness to take action and subsequent action actually taken, could be useful. Future studies should include more participants to provide a larger, representative population of youth. Future research could also look to explore the EIF as it relates to diverse populations, ie. race or social development status. It may be interesting to conduct similar research post Covid-19 epidemic. Online forums could be utilized to broaden target audiences as well as obviate geographical constraints.

X. Conclusion

Climate change is a complex issue and will require a multifaceted approach for mitigation. The youth perspective has been previously less studied, but must be included as their futures will be most impacted. Effective communication around climate change is a good start. Deliberation is a powerful means for creating constructive conversation around climate change, and for better understanding its effects, which can ultimately lead to action. The data collected through the forums highlighted the strongest and weakest aspects of EIF as a means of deliberation. It is this researcher's hopes that through this greater understanding, lies increased action and civic engagement for the future. Although spatial and temporal constraints existed, this study still provided an initial exploration of efficacy. The present research is a glimpse into the potential that deliberation offers climate change communication and mitigation. Future research should continue to explore the educational values of deliberative pedagogy, as more information is needed for better communication that can be the key to increasing pro-environmental action.

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Appendix A: Survey

Understanding Pathways to Engage Youth to Act on Climate Change Mitigation and Adaptation Informed Consent

Hello High School Students!

Thank you for participating in our new research project – Understanding Pathways to Engage Youth to Act on Climate Change Mitigation and Adaptation. We are very happy to work with you in this climate change education program. This project is funded by National Science Foundation (NSF). Climate science communication is one of the biggest issues we face today. We, as scientists, are interested in studying the effectiveness of deliberation democracy pedagogy to communicate climate change. To understand the effectiveness of the program, we are interested in understanding how participants view the program and how the program affects students' knowledge and hope towards climate change. We hope to take the input from you and use it to improve climate change communication. We appreciate you taking the time to participate in the program and fill out the pre- and post- survey. The survey will take about 10 minutes to complete. There is no risk to you to participate, and your responses to this survey will be kept anonymous. The only benefit we can offer is the learning experience in sharing and hearing from each other about how we can work together to help with the environment and our community. Your participation in this project is voluntary and you may discontinue your involvement at any time.

Please complete the pre-and post-forum surveys before and after you participate in the program and return them to your counselor.

If you have any questions about the survey, please do not hesitate to contact us at any time. Thank you for your help.

Sincerely,



Sara Thuston, Research Assistant
School of Natural Resources
University of Missouri

Setdn2@mail.missouri.edu
314-943-4195

Climate Change Forum Pre-Questionnaire

Birthdate: _____

Q1. Recently, you may have noticed that climate change has been getting some attention in the news. Climate change refers to the idea that the world’s average temperature has been increasing over the past 150 years, may be increasing more in the future, and that the world’s climate may change as a result. What do you think? Do you think that climate change is happening?

- Yes
- No
- Don’t know enough to say

Q2. Assuming climate change is happening, do you think it is...

- Caused mostly by human activities
- Caused by both human activities and natural changes
- Caused mostly by natural changes in the environment
- None of the above because climate change isn’t happening
- Other
- Don’t know

Q3. Personally, how well informed do you feel you are about ...

	Not at all informed	Not very well informed	Fairly well informed	Very well informed
How the Earth’s “climate system” works	1	2	3	4
The different causes of climate change	1	2	3	4
The different consequences of climate change	1	2	3	4
Ways in which we can reduce climate change	1	2	3	4

Q4. The “greenhouse effect” refers to

- Pollution that causes acid rain
- The Earth’s protective ozone layer
- Gases in the atmosphere that trap heat
- How plants grow
- Don’t know

Q5. How much do you disagree or agree with the following statements?

(1=strongly disagree; 2= disagree; 3=slightly disagree; 4=neutral; 5=slightly agree; 6= agree; 7 strongly agree)

1. I am hopeful about resolving climate change because more people are taking climate change seriously. 1 2 3 4 5 6 7

2. I know that there are a number of things that I can 1 2 3 4 5 6 7

do to contribute to climate change solutions.

- | | | | | | | | |
|---------------------------------------------------------------------------------------------|---|---|---|---|---|---|---|
| 3. I am hopeful about climate change because I can
of many ways to resolve this problem. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 4. I am willing to take actions to help solve
problems caused by climate change. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Q6. What actions do you think that we could take in our community to lessen and adapt to climate change? Please explain the reason in a couple sentences.

Q7. How much do you disagree or agree with the following statements?

(1=strongly disagree; 2= disagree; 3=slightly disagree; 4=neutral; 5=slightly agree; 6= agree; 7 strongly agree)

- | | | | | | | | |
|------------------------------------------------------------------------------------------------------|---|---|---|---|---|---|---|
| 1. Science can help me better understand the world. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2. Science will help me better understand my effect
on the environment. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 3. I think that society should use scientific methods
to make good decisions. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 4. Learning or collecting evidence in science is
important and enables us to make good decisions. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 5. Knowledge of science helps us understand issues
such as climate change. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Climate Change Post-Questionnaire

Birthdate: _____

Now that you've had chance to participate in a talk and a forum on climate change, we'd like to know what you are thinking. Your perspective along with those who participated the talk will be part of a report to inform the design of future education and outreach events on this issue. Thank you!

Q1. Do you think that global warming is happening?

- Yes
- No
- Still not enough information

Q2. Assuming global warming is happening, do you think it is...

- Caused mostly by human activities
- Caused by both human activities and natural changes
- Caused mostly by natural changes in the environment
- None of the above because global warming isn't happening
- Other
- Don't know

Q3. Personally, how well informed do you feel you are about ...

	Not at all informed	Not very well informed	Fairly well informed	Very well informed
How the Earth's "climate system" works	1	2	3	4
The different causes of global warming	1	2	3	4
The different consequences of global warming	1	2	3	4
Ways in which we can reduce global warming	1	2	3	4

Q4. The "greenhouse effect" refers to

- Pollution that causes acid rain
- The Earth's protective ozone layer
- Gases in the atmosphere that trap heat
- How plants grow
- Don't know

Q5. How much do you agree or disagree with the following statements? (Youth)

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
Schools should teach children about the causes, consequences, and potential solutions to global warming.					

Climate change will cause damaging changes for me and my community in my lifetime.					
Since the US is one of the world's largest greenhouse gas producers, it should take the lead in reducing emissions of CO ₂ .					

Q6. Do you favor or oppose the following actions?

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
Encourage Americans to use less energy by taxing fossil fuels, EVEN IF this burdens poor Americans by increasing the costs of necessities and commuting to their jobs.					
Ease the rules for bringing new "green" technologies to the market EVEN IF there's a chance they could harm human health and safety.					
Increase the use of electric vehicles and redirect highway funds to create bike lanes, car-free zones and pedestrian-friendly neighborhoods, EVEN IF these actions will take a long time to produce any significant cuts in carbon emissions.					

Q7. Did you hear and talk about aspects of the issue you hadn't considered before? If yes, what were they?

Q8. How much do you disagree or agree with the following statements?

(1=strongly disagree; 2= disagree; 3=slightly disagree; 4=neutral; 5=slightly agree; 6= agree; 7 strongly agree)

5. I am hopeful about resolving climate change because more people are taking climate change seriously. 1 2 3 4 5 6 7

6. I know that there are a number of things that I can do to contribute to climate change solutions. 1 2 3 4 5 6 7

7. I am hopeful about climate change because I can think of many ways to resolve this problem. 1 2 3 4 5 6 7

8. I am willing to take actions to help solve problems caused by climate change. 1 2 3 4 5 6 7

Q9. What actions do you think that we could take in our environment to lessen and adapt to climate change? Please explain the reason in a couple sentences.

Q10. How much do you disagree or agree with the following statements?

(1=strongly disagree; 2= disagree; 3=slightly disagree; 4=neutral; 5=slightly agree; 6= agree; 7 strongly agree)

6. Science can help me better understand the world. 1 2 3 4 5 6 7
7. Science will help me better understand my effect on the environment. 1 2 3 4 5 6 7
8. I think that society should use scientific methods to make good decisions. 1 2 3 4 5 6 7
9. Learning or collecting evidence in science is important and enables us to make good decisions. 1 2 3 4 5 6 7
10. Knowledge of science helps us understand issues such as climate change. 1 2 3 4 5 6 7

Q10. Are you thinking differently about climate change now that you have participated in the forum?

- Yes
 No
 If yes, please explain:

Q11. What actions do you think that we could take in our environment to lessen and adapt to climate change? Please explain the reason in a couple sentences.

Science can help me better understand the world
science will help me better understand my effect on the environment

I think that society should use scientific methods to make good decisions
learning or collecting evidence in science is important and enables us to make sound decisions
knowledge of science helps us understand issues such as climate change

Demographics

Please tell me something about yourself...

1. I am: Male Female Preferred not to say

2. I am: Hispanic/Latino Not Hispanic/Latino

3. What best describes the area that you live in? Rural Urban Suburban

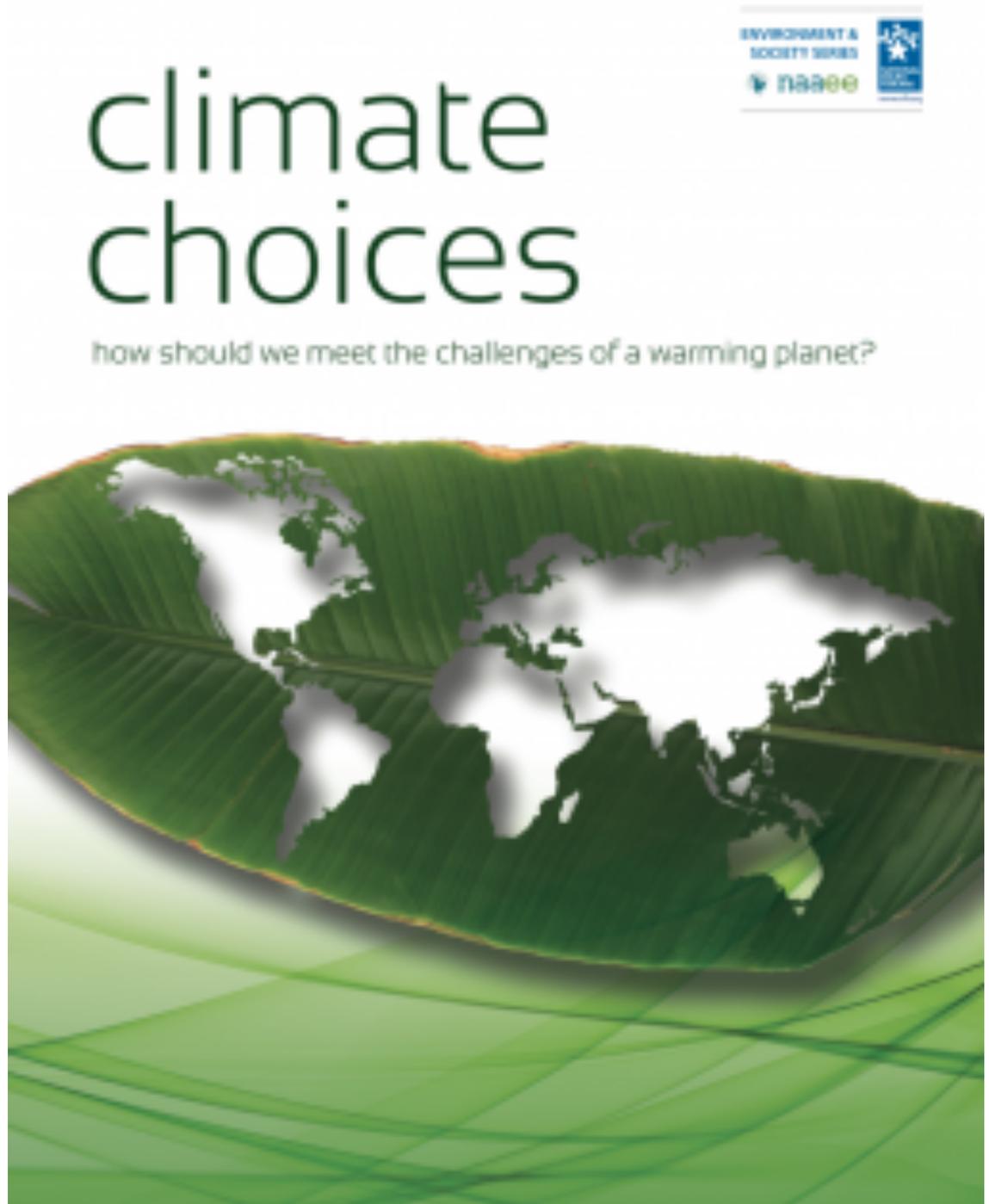
4. What is your race?

- American Indian or Alaskan native
- Asian or Pacific Islander
- African American or Black
- White
- Two or more races
- Other (Please specify) _____

Thank you!

Appendix B: Toolkit

I. Climate Choices: How Should We Meet the Challenges of a Warming Planet?



II. Environmental Issues Forum Procedure

Materials: EIF Climate Choices guidebooks, pens, markers, (thick) paper for nametags, access to a clock

Set-up: When you arrive to the location, set up the video and make sure both the audio and visual are functioning. Distribute Climate Choices guidebooks to all participants. Have participants create a name card tent (fold paper into tent form).

- I. Welcome/introduction – Tell the audience who you are and what you do, with a short explanation of your purpose for being there
- II. Ground rules – Explain the ground rules
 - a. Pay attention
 - b. Listen to one another
 - c. Respect one another's opinions
 - d. Participate – the more you share, the more you get out of the activity
 - e. Anonymity reminder
- III. Pre-survey – Administer the pre-survey and allow enough time for everyone to finish ~10 minutes
- IV. Video – Play the video (adjust lights and sound accordingly) ~10 minutes
- V. Warm up question/first reaction to video – Invite participants to share their initial reaction to the video, emotions and thoughts, or personal/relevant experiences
- VI. 3 options discussions – Give participants ~10 minutes to read the appropriate section before the start of the discussion
 - a. Option 1: reduce carbon emissions
 - b. Option 2: prepare and protect our communities
 - c. Option: accelerate innovation
 - i. Each choice discussion should be between 20-30 minutes long – It is your job as the facilitator to keep the discussion moving as well as transition to the next topic appropriately
 - ii. Familiarize yourself with the supplemental sample questions on the following page
- VII. If possible, take notes
 - a. This is much easier if there are 2 facilitators
 - b. These notes are for the participants to refer to during the discussion

- c. This is easiest if in a classroom with a white board or if you have access to an easel/pad
- VIII. Final thoughts – Encourage participants to each share their final thoughts or something they learned from the forum
- IX. Post-survey – Administer the post-test and allow enough time for everyone to finish ~15 minutes
- X. Collect the Climate Choices guidebooks, dismiss the participants, and say thank you

III. Supplemental Sample Questions

Climate choice #1

- How have you, your family, or other people you know tried to cut down on your personal CO₂ emissions? Did anything make it difficult?
- What do you think is the best way to reduce emissions of CO₂ or other greenhouse gases in the United States? Why?
- How much are you willing to invest in weatherizing your home, installing clean power systems, or making other changes that help address climate change? Do you think changes like these should be required?
- How much more would you be willing to pay in energy costs to allow for “cleaner” energy?
- Would you be willing to deal with more regulations as an individual or as a business owner in order to collectively reduce emissions?
- Would you be willing to change your lifestyle—eat differently, ride a bike or take public transportation more often, lower your home thermostat—in order to reduce carbon emissions? Do you think changes like these should be required?
- How does this option address our concerns about climate change?
- What worries or makes us uncomfortable about this approach?
- If this approach worked perfectly, what would the trade-offs or consequences be?

Climate choice #2

- If we help farmers adapt to climate change, are we obligated to help other industries?
- If climate change is almost certainly going to cause noticeable changes to the places we live in, how much change are we prepared to accept?
- This option is mostly about protecting human communities—but what about wildlife and/or special natural areas? Do we want to protect those as well?
- Climate change will likely result in health problems, especially among children and the elderly. What do we owe others in our communities to help them adapt?
- How should we balance individual rights and the good of the community, especially when it comes to property rights?
- Does focusing on adaptation rather than reducing CO₂ emissions renege on our obligations to people in other countries?
- How does this option address our concerns about climate change?

- What worries or makes us uncomfortable about this approach?
- If this approach worked perfectly, what would the trade-offs or consequences be?

Climate choice #3

- This option assumes we'll be able to keep our current way of life—including the amount of energy we use and waste we create—through innovation. Is consumption itself an issue to be considered?
- Are you concerned about unintended consequences of new experimental technologies?
- How important is cost-effectiveness when considering new technologies?
- Do you think that relying on technological change will address the problems of climate change quickly enough?
- What are the best ways to encourage widespread adoption of new technologies and ways of doing things? Should this be mandated?
- Does this option risk giving too much power and discretion to private companies?
- How does this option address our concerns about climate change?
- What worries or makes us uncomfortable about this approach?
- If this approach worked perfectly, what would the trade-offs or consequences be?

IV. Climate Change Video (transcribed)

Title: Climate Choices – How Should We Meet the Challenges of a Warming Planet?

National Forums Institute, 2016

Producer: Murray Wasyluk

Animation: Philip Robinson

Original Music: Graeme Wearmouth

Voiceover Recording and Mix: Sheldon Zaharko

Farmers in California, city dwellers in coastal cities, families in small towns throughout the south and Midwest: everyone is dealing with different effects of climate change. Whether it is unusual snowfall, longer summers, deeper droughts, more destructive wildfires, or stronger storms, things are getting unpredictable. At the root of these climate changes is global warming, caused mainly by rising levels of gases in the atmosphere. Particularly carbon dioxide, or CO₂. These greenhouse gases act like a blanket, driving the earth's temperature up, and overwhelming its natural heat regulating systems like oceans, soils, and forests.

The United States and china are responsible for the largest percentages of the world's CO₂ emissions, mostly from burning fossil fuels like coal and oil for energy, industrial production and transportation. But everything from the cars we drive to the transportation and packaging of our food adds to the problem. Most researchers expect the effects of climate change to get stronger over the next 10 to 20 years. A rapidly changing and unpredictable climate has its financial costs like higher insurance rates and disaster relief, but there are also health problems,

like asthma, and heat related illnesses to consider. Our food sources will be affected, and so will be oceans, forests, and wildlife areas. Climate change is even a national security concern.

When people talk about climate change, it's clear: they are concerned about things that we all hold dear. Our health, our homes, our children and communities, our environment, our livelihoods, even our personal safety. But to deal with it will require actions that are also pose risks to our freedom, our livelihoods, and our communities. There is a lot of agreement about the basic science of climate change. What's not so clear and what we have to decide is what we're willing to do and what we're willing to risk as individuals, as communities, and as a nation, in order to take action.

We will be deliberating about three options for dealing with climate change. These options were not posed by political parties or experts. They were developed by talking to people throughout the country about the risks from climate change that they fear most, and the actions that seemed likely to protect what they hold most valuable. As we decide how to address the problems, we also need to consider the drawbacks and tradeoffs of our approaches to make sure we can live with the consequences.

So, let's look at our options:

Option one: sharply reduce carbon emissions. This option says we need to take aggressive action to reduce our energy consumption, and change climate change behaviors. If we don't move swiftly to tackle the problem at its source, we risk catastrophic effects that we and future generations may not be able to adapt

to. What if we created a national, low-emissions standard, that required states to get a certain percentage of their energy from renewable sources. That would reduce emissions. But low-carbon energy sources, especially nuclear, have their own downsides. Or, we could levy a carbon fee on fossil fuel providers that reflects the true cost of carbon fuels. But these costs will likely be passed onto consumers, affecting the basics, like food and gas prices. That would be particularly hard on poor people. Requiring the use of electric vehicles would address one of the major sources of carbon emissions. We could also divert some highway funds to pay for bike lanes and to help develop pedestrian friendly neighborhoods. But these are long-term changes that will take years to implement. So, we wouldn't see reductions in carbon emissions for quite a while. The downside to all of these actions is that they limit our personal choices and freedom, and some people, communities, businesses would be more affected by the changes than others. Could we live with that?

Option two: prepare and protect communities. This view focuses on protecting and preparing communities and businesses for the most likely effects of climate change by planning ahead, and strengthening our resilience to the impacts we face. So, for example, we could change land use regulations, zoning, building codes, and insurance rules to keep people from living, and building in areas most at risk to climate change hazards. And get those currently living in vulnerable places to move. But, these changes will infringe on property rights, and impose large economic burdens on some property owners, while enhancing the property values of others. Communities could also adapt to rising sea levels

by investing in more resilient buildings and infrastructure in coastal areas. But this would change the landscape in many communities and add huge costs to construction.

We might prepare for climate change disasters by increasing access to cooling centers, emergency food, housing, and healthcare treatment, so that those affected can cope with long heat stress, hunger, illness, or even homelessness. But the task might be too great for charities, social services, and local organizations. The actions in this approach do little to slow climate change, so it means accepting greater environmental damage. And some people in communities will need to make bigger changes and sacrifices than others. Can we accept that?

Option three: accelerate innovation. This option says people have always adapted to changing conditions and that we should allow that to happen now, encouraging people's natural problem-solving instincts to address this shared problem. In this view, we should invest in rapid innovation to develop new fuel sources, new ways of generating power, new ways to influence earth's climate, and even new societal arrangements. For example, the government could offer incentives for companies to create low-carbon technologies for energy storage, water reclamation, recycling of mining waste, and sustainable agriculture. But this would put the government in a position of choosing winners and losers for projects, and would interfere with the private sector.

We could also accelerate research and development on scientific methods for offsetting the effects of high CO₂ levels in the atmosphere. This is called

geoengineering. But, this would be new and untested technology that could have unintended like damaging earth's protective ozone layer, causing weather disruptions, or something else we can't anticipate. What if we use data from technologies like smart electric meters in homes and GPS enabled communications systems in cars, combined with peer pressure and social networking to motivate people to reduce their energy use. But, this could raise concerns about privacy and data security, and would make us all subject to peer and public pressure.

Some of these new technologies will undoubtedly fail, and the risk in all of these actions is not making progress quickly enough to avert the worst climate change impacts. And there may be significant unintended consequences for the environment, human health, the economy, and the balance of our social and economic systems. Can we live with those risks?

These three options are the starting point for our conversation. Each protects certain things we hold valuable but leaves others at risk. And in order to take action on a problem as huge as climate change, we need a way forward that everyone is willing to contribute to. We've got some hard choices to make, so let's get talking.

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