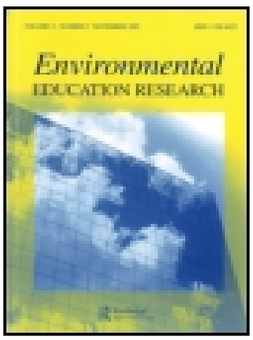

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Exploring the essential psychological factors in fostering hope concerning climate change

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ABSTRACT

Hope is an important component that helps engage people in solving problems. Environmental educational resources addressing climate change effectively should ideally nurture hope as well as increase understanding about the issue. However, hopefulness about resolving climate change challenges is a relatively new construct in the literature and little is known about it. To understand the factors that affect hope, we assessed hope using the reasonable person model and hypothesized that students are more likely to be hopeful and work toward solutions if they: (1) are able to make sense of information (model building); (2) perceive there are actions they can take (meaningful action); and (3) believe that society and laypeople have the ability to undertake actions to make a difference (being effective). We surveyed 728 high school students between September 2013 and January 2014 and found that students' belief of competency (being effective) is a significant and direct path to hope.

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Hope about climate change; path analysis; reasonable person model; high school students

Background

Climate change is one of the most challenging environmental issues that we are facing today (IPCC 2013). Bringing about solutions to this issue will likely require the dedicated engagement of many people, and that may be more likely if they are hopeful about this challenge. Environmental psychologists and mental health professionals worry that 'environmental grief' and 'eco-despair' is a barrier to environmental engagement (Kevorkian 2004). When it comes to solving global problems such as climate change, young people often feel helpless and pessimistic in working toward solutions despite their interest (Bentley, Fien, and Neil 2004; Connell et al. 1999; Eckersley 1999; Fleer 2002; Hicks 1996, 2001). These young people can play a role in decisions and actions to mitigate and adapt to climate change. A special panel at the 42nd North American Association for Environmental Education annual conference in 2013 stressed the importance of nurturing hope and identified it as one of the goals for climate change education. Other researchers have also emphasized that climate change education programs need to focus more on building sense of hopefulness as well as promoting understanding of the issue because high-hope people are more likely to be actively engaged in mitigating and adapting to climate change (Center for Research on Environmental Decisions 2009; Lueck 2007; Ojala 2007, 2012, 2015).

Positive psychologists discovered and identified hope as an important element in engaging people in solving problems (Snyder 1994). Hope is not only a pleasant feeling but also a motivational force. Hope is based on the assumption that people are goal oriented; it involves an overall perception that

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goals can be met and that the expectancies for goal attainment can explain diverse behaviors (Erickson, Post, and Paige 1975; Farber 1968; Frank 1968; Gottschalk 1974; Menninger 1959; Mowrer 1960; Stotland 1969). The predominant view is that people with greater hope are likely to achieve their goals and be actively engaged in problem solving and experience more positive outcomes. Snyder, Irving, and Anderson (1991) expanded the hope construct, defining it as a cognitive construct composed of sense of successful agency (willpower) and pathways thinking (waypower) toward goals. Agency thinking refers to the belief that one is capable of executing the means to attain certain goals. Pathways thinking refers to the belief that one is capable of conceiving these means. It is similar to Self-Efficacy Theory, the belief in one's capabilities to find and execute courses of action and the expectations about the consequences of an action which help nurture effort, resilience, serenity, and optimism in the face of adversity and to solve problems (Bandura 1995, 1997). Hope Theory builds on the goal-driven and pathways components of Self-Efficacy (Snyder, Rand, and Sigmon 2001). Hope Theory manifests some similarities to self-efficacy and other constructs, such as optimism and problem solving, and yet it has sufficient differences so as not to be a proxy for an already existing theory (Snyder, Rand, and Sigmon 2001). Compared to self-efficacy, Hope Theory explicitly emphasizes the perceived pathway thinking related to solve a problem. Whereas, self-efficacy emphasizes on the efficacy belief and outcome expectancy when adopting a new behavior (see Table 1).

Hope provides psychological and mental power to mitigate helplessness and regulate anxiety. Empirical evidence suggests that hope is strongly related to academic achievement (Snyder et al. 2002), coping responses to stressors and obstacles (Barnum et al. 1998), positive psychological health (Snyder, Irving, and Anderson 1991), and recovery from depressive symptoms (Klausner and Alexopoulos 1999). For example, a 6-year longitudinal study with college students reveals that hope was positively associated with mean grade point average (GPA) scores ($r = .21$). The regression analysis suggests that college students who have a higher level of hope tend to have a higher level of GPA after controlling for their baseline scores (Snyder et al. 2002). Day et al. (2010) found that hope offers a unique impact on personal achievement that is explained by intelligence, personality, and previous academic achievement in a sample of 129 college respondents.

Rationale for the reasonable person model

The reasonable person model (RPM) (Basu and Kaplan 2015; Kaplan and Kaplan 2009) is a synthesis of several theories that help describe the supportive environments that enable people to thoughtfully and helpfully engage in solving problems. It also describes situations that are prone to create anger, frustration, apathy, or any not-so thoughtful or helpful attitudes. Because it defines supportive environments as those that meet our need for information, this model is particularly relevant to education-based interventions. While hopefulness and reasonableness are not identical outcomes, they should be related. Both hopefulness and reasonableness not only address individual perception

Table 1. Implicit and explicit operative process and their respective emphases in Hope Theory as compared with self-efficacy, and optimism.

Operative process	Hope	Optimism: Seligman	Optimism: Scheier and Carver	Self-efficacy	Outcome expectancy
Attributions		+++			
Outcome value	++	+	++	++	+++
Goal-related thinking	+++	+	++	+++	++
Perceived capacities for agency-related thinking	+++		+++	+++	
Perceived capacities for pathways-related thinking	+++		+	++	

Note: This table is adapted from (Snyder, Rand, & Sigmon, 2002, 261).
+Operative process is implicit part of model.
++Operative process is explicit part of model.
+++Operative process is explicit and emphasized in model.

of individual change, they but also look at problems that are often at community and societal level, broaden than individual. Ojala (2012, 2015) explored the perception if others' work in climate change is one of the sources of hope concerning climate change, broadening that construct. RPM has the same potential while focused on how individuals can make a difference. The key aspect is the characteristics of the supportive environment, perception of others' mental models, others' efficacy, and others' strategies could help build an individual sense of support and reasonableness. They are both in the affective domain and share the same ultimate purpose–to enable people to purpose the goals and solve problems. The purpose of this paper is to explore the three factors of RPM to assess their ability to predict hopefulness. Understanding this relationship between RPM and hope will suggest strategies to cultivate hopefulness through instructional activities.

The RPM framework has been successfully applied in designing educational activities, conveying problem solving skills, nurturing youth development, engaging the public in environmental issues, and encouraging environmental behavior (Basu and Kaplan 2015). Three essential informational needs are theorized to promote a supportive environment that fosters reasonableness (Kaplan and Kaplan 2009) (Figure 1). We hypothesize that these three factors will have a relationship with hopefulness.

The first domain from the RPM, model building (MB), suggests people need to understand the issue and create a mental model that helps them make sense of the world and come to decisions. Effective learning and information sharing can build mental models (Zaksek and Arvai 2004). In this study, we defined model building as a variable that describes participants' level of knowledge and understanding of climate change which will enable them to be comfortable and confident in their knowledge. The second domain, being effective (BE), addresses the need to build capacity and competence, and to avoid frustration and mental fatigue. This factor describes the extent to which people perceived that they have the skills and are able to take actions and address problems. Local examples or a how-to-manual are potential ways to nurture and sustain effectiveness. The third domain, meaningful action (MA), describes the need for people to know how and believe they can participate in making a difference. If people perceive that there are actions they can take that will be useful, they are more likely to feel hopeful. Kaplan and Kaplan (2009) suggest that knowledge (MB) and competence (BE) enable people to make a difference and take actions; people also receive feedback from taking actions (MA) that influences the richness of their mental models and sense of competence.

Developing a hypothesized path model

In developing a model, we first hypothesized that MB, BE, and MA are positively correlated with hope and influence each other to help create or enhance hopefulness. We also acknowledged that several other factors could influence hope and included seven background and contextual variables.

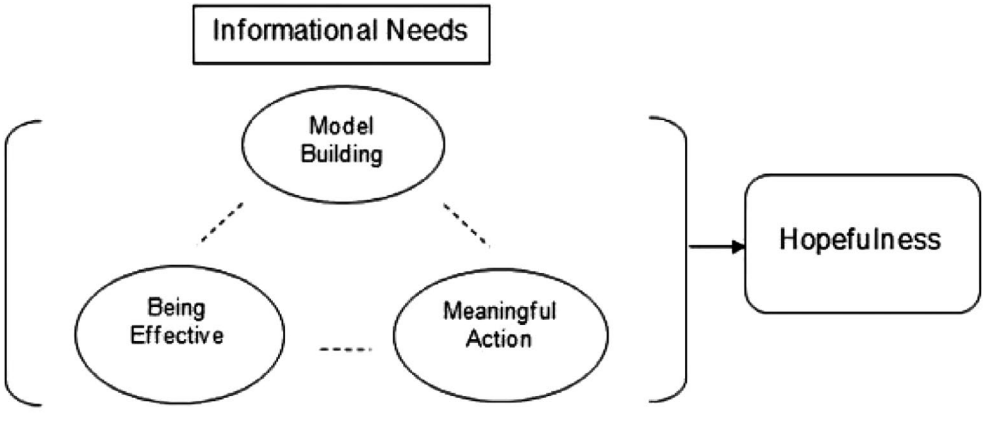

Figure 1. Theoretical framework adapted from the Reasonable Person Model.

The background variables (gender, race, and grade level) allow the model to test whether or not the effects of a variable to another variable are due to the shared common causes (Wuensch 2015). Background variables that are related to hope in psychiatric literature include gender, ethnicity, housing, and income (Hodges, Hardiman, and Segal 2004). We hypothesized that hope about climate change could be a function of gender and ethnicity in this limited case of high school students. There is no strong theoretical reason on how grade level will affect hope but we included it as a proxy for age and experience for exploratory reasons.

We administered the survey in the beginning of the classes in which students learned about the role of forests play in mitigating climate change. Students completed the survey before they did activities as the baseline measure. We hypothesize that the prior opportunities for involvement in forest management will lead to the greater hopefulness since participation in voluntary organizations shows a direct relationship to hope (Zimmerman 1990). We operationalized this prior opportunity in three items to explore how nearby forests affect hope: the opportunities to manage forests, whether or not respondents know people who manage forests, and whether or not their family owns forest land. Each of the constructs is explained in the methods section. Understanding how context and background variables affect hope will enable educators to predict the variations among the audience, help them be prepared to accommodate audience differences, and design instructional activities to effectively engage learners and foster hopefulness about climate change. Adding these seven variables should not only increase the accuracy of the path analysis, but also allow us to determine the coefficients of these variables on hope in this context.

An additional variable was added to the model based on a recent study that found climate change knowledge and worldview interact to influence adolescents' beliefs about anthropogenic climate change through environmental concern (Stevenson et al. 2014). In examining hope concerning climate change and its predictors, Ojala (2007) suggests that the degree of environmental concern varies with hopefulness. Based on these studies, climate change concern was added as an important mediator of hope.

In summary, there are three main hypotheses associated with the path model (Figure 2).

Hypothesis 1. Students are more likely to be hopeful if they: 1) are able to make sense of information (MB); 2) believe that society and laypeople have ability to undertake these actions (BE); and 3) perceive there are actions they can take to make a difference (MA). If so, MB, BE, MA, and hope will be significantly correlated.

Hypothesis 2. Environmental concern is a predictor that associated with MB, BE, and MA. If so, environmental concern will affect hope through MB, BE, and MA.

Hypothesis 3. A combination of RPM constructs and demographic context variables can better predict hope about climate change than a model containing only RPM constructs or demographic context variables.

Research questions

The quantitative approach taken in this study enabled examination of the major research question: What is the relationship between hope, MB, BE, MA and environmental concern when controlling for context and background variables? This is an exploratory study. The research question is shown in the hypothesized path model in Figure 2.

Methods

Participants and procedure

High school students ($n = 728$) from 18 schools in the 6 southeastern States in the United States, including Florida (43.25%), Virginia (24.25%), Arkansas (.25%), Georgia (2.00%), Kentucky (19.75%), and North Carolina (10.00%), participated in the study. Data were collected during fall 2013 and early January 2014. Students were equally divided by gender (51% male); about 64% were 11th and 12th graders and 36% were 9th and 10th graders.

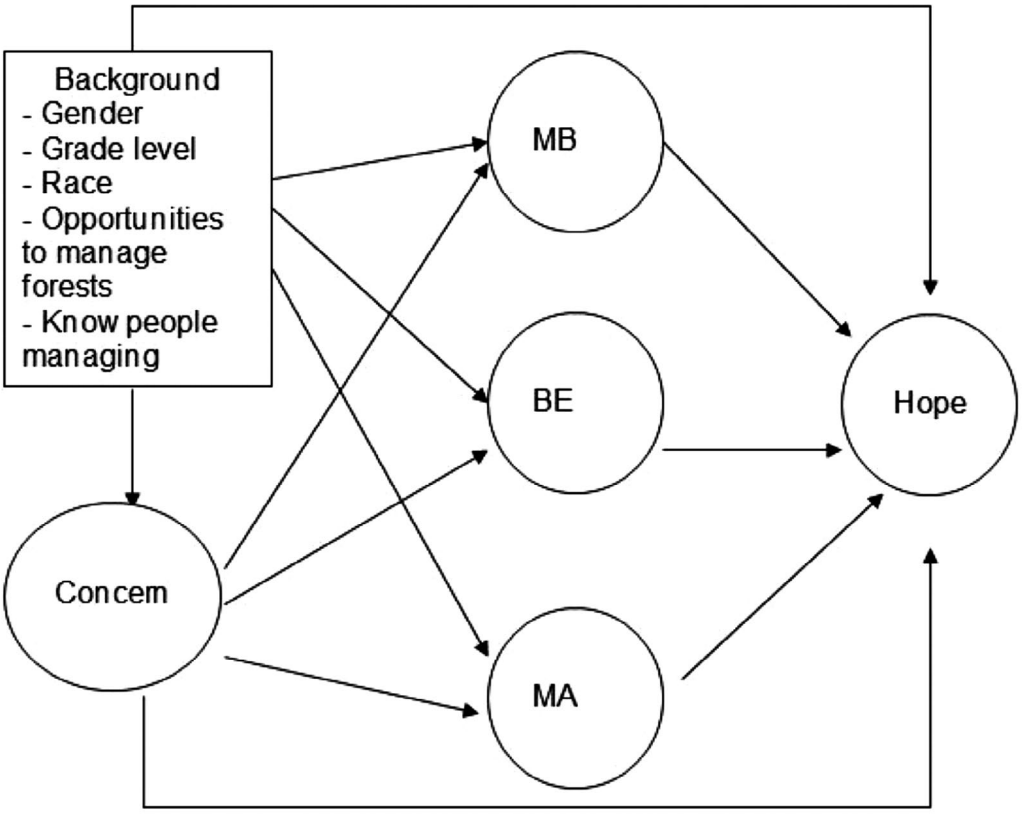

Figure 2. Originally hypothesized direct paths (concern = concern about climate change, MB = model building, BE = being effective, MA = meaningful actions, hope = hope concerning climate change).

Following approval from the University Institutional Review Board, the instruments, parental consent forms, and assent scripts were sent to teachers. We purposefully selected 28 out of 123 teachers. The selective sampling allows us to recruit teachers from eight States across the Southeastern United States. Teachers collected parental consent forms from parents or guardians and administered the survey to students during their regular instruction time. Instructions were provided through an online training website and communicated via emails to ensure teachers understood the purpose of the study and the appropriate way to administer the surveys.

Instruments

The survey included questions to measure student knowledge about climate change (model building), beliefs regarding necessary ability for taking action (being effective), perceptions about actions they can take (meaningful action), concern about climate change, hope about their ability to influence climate change solutions, and demographic questions. To ensure instrument validity, a research advisory committee with 6 experts and a group of environmental education (EE) graduate students reviewed the questionnaire and confirmed that it included items that measure hope, RPM variables, and demographic and context variables. A high school science teacher checked the appropriateness of wording and reading level. The questionnaire was pilot tested with 89 high school students during summer 2013 and revised to incorporate reviewer, teacher, and student feedback. Appendix 1 includes the questionnaire questions that were employed in this study.

Measuring latent variables

Model Building (MB) was defined as students having a common understanding of climate change. A scale with three items measured knowledge and perceptions of climate change. The questions were adapted from American Teen's Knowledge of Climate Change (Leiserowitz, Smith, and Marlon 2011). These items are related to the causes and impacts of climate change. The range of each individual is total score from 0 (minimum) to 3 (maximum). A higher score indicates greater knowledge and science-based perception of climate change.

Being Effective (BE) was defined as the belief that society and laypeople have the ability and skills to undertake actions**.** The items were guided by Bandura's Self-efficacy Theory (1997, 1995) and adapted from General Self-Efficacy Scale (Schwarzer and Jerusalem 1995) and Collective Efficacy Scale (Goddard 2002). The scale contains four items, each defined by a 7-degree rating scale from strongly disagree (1) to strongly agree (7) with neutral in the middle (4). The range of individual's total score for this section is from 4 (minimum) to 28 (maximum). A higher score indicates stronger belief that they, society, and laypeople have ability and skills to undertake actions.

Meaningful Action (MA) was one of the sources of climate change hopefulness that emerged from interviews conducted by Ojala in 2007. It is a 5-degree scale that captures the extent students perceive there are actions that different sectors can take to make a difference. The stem is 'how much can each of the following types of people help to address climate change?' Those sectors are: 'middle/high school students,' 'farmers,' 'forest landowners,' and 'scientists' from 1 (nothing) to 5 (a lot). The range of individual score is from 4 (minimum) to 20 (maximum). A higher score indicates a stronger perception that these types of people can take actions to make a difference.

Hope Concerning Climate Change items were based on The Trait Hope Scale (Snyder, Rand, and Sigmon 2001) to capture agency and pathways thinking on a 3-item and 7-point agree and disagree scale. The range of the individual's total score is from 3 (minimum) to 21 (maximum). Higher scores indicate stronger hope.

Concern about Climate Change (Concern) was measured by an adaptation of one statement from Environmental Worry Scale (Bowler and Schwarzer 1991), with a 4-degree scale from 1 (not at all) to 4 (a great deal). The range of the individual score is from 1 (minimum) to 4 (maximum). Higher scores indicated stronger concern about climate change.

Demographic and context variables

Participants completed several demographic questions including gender, grade level, and race. For context variables, participants responded to the question 'Are there any opportunities for you to learn about forest management practices?' by selecting one of four options: yes, with my family; yes, with my school; no, but I would like to learn more about it; no, and I am not interested. They were also asked 'Do you know people who manage forests?' for which there were four options (yes, my family; yes, my neighbors; yes, people in the area; no) and 'How many forested acres does your family own?' with four options (none; less than 5 acres; 6–100 acres; more than 100 acres).

Limitations

Some limitations of this study may provide considerations for future research. First, respondents were not randomly selected and teachers who participated in the study wanted to teach about climate change. This may increase the possibility that teachers were hopeful and may impact their students, but should not alter the relationships between variables. Non-probability samples of convenience, however, constraint the ability to generalize. The interpretation of causal effects relies on the source of samples and must be interpreted with caution. Second, hope and perceptions about climate change as described earlier are complex constructs that may not be gauged simply from causal modeling procedures. The limitation is that if the measures do not capture every aspect of climate perceptions,

there is the potential for bias. The survey asked for a substantial amount of information, limiting the time students could spend answering these items. Therefore, we developed a relatively short survey to collect data. A longer survey with more statements may have more accurately measured for each construct. Qualitative methods are needed to explore other potential factors that could be omitted from the casual and factor model.

Analysis

Structural equation modeling

We used hybrid non-recursive structural equation models with a WLSMV estimator, a type of path analysis technique, to examine the direct and indirect effects between observed demographic and contextual variables, concern about climate change, model building, being effective, meaningful action, and hope concerning climate change. The path analysis is based on the assumption that the covariance matrix of the observed variables is a function of a set of parameters of the model. Although criticisms have not gone unnoticed, path analysis techniques still make significant contributions to theory as they allow the testing of relations between variables when theoretical and empirical support is present (Grapentine 2000; Kline 2011). If the model is accurate and parameters are known, then the covariance matrix of observed variables is equal to the model-based covariance matrix.

The model included a set of exogenous and endogenous variables. The variance of exogenous variables, such as gender, grade level, race, opportunities, knowing people who manage forests, and owning forests, was assumed to be caused entirely by variables not in the causal model. The variance of endogenous variables, such as concern, MB, BE, MA, and hope, was considered to be explained in part by the other variables in the model. Hybrid non-recursive structural equation models represented a mix of path analysis (path model) and confirmatory factor analysis (measurement model) and allow the use of both observed variables and latent variables. The path model specified the relationships among the variables while the measurement model estimated the factor loadings and the measurement errors between the observed indicators and the latent variables specified in the path analysis. The measurement model and path model were simultaneously estimated. The correlations or covariance matrix between latent variables served as the input to estimate the path coefficients between variables. Using the latent variables approach enabled analysis of the psychometric properties of the measures and identified the causal determinants and mediators of the variables within the conceptual framework. The findings will contribute to the theoretical grounding of determinants of hope, which can be used by educators and researchers alike.

Model fit indices

We estimated models by using Mplus Version 7.11 (Muthén and Muthén 1998–2012). We treated all the scale items in the models as ordinal data. The WLSMV is a robust estimator which does not assume normally distributed variables for modeling categorical or ordered data (Brown 2006). The five model fit indices chosen as indicators of a well-fitted model were the chi-square goodness of fit (χ^2), root mean square effort of approximation (RMSEA), Comparative Fit index (CFI), the Tucker Lewis index (TLI), and weighted root mean square residual (WRMR). Each index has a different parameter to indicate fitness. Models with CFI and TLI values close to or larger than .95 are normally considered an acceptable fit (Hu and Bentler 1999). In addition, MacCallum, Browne, and Sugawara (1996) have used value of .01, .05, and .08 of RMSEA value to indicate excellent, good, and mediocre fit, respectively. Models with WRMR close to or larger than .95 indicate a good fit.

Results

The model fit indices indicated that the final model is acceptable ($\chi^2_{146} = 342.99, p < .05$; RMSEA = .04; CFI = .97; TLI = .95; WRMR = .95). The means, standard deviations, and factor loading values for the

subscales of the latent variables are listed in Table 2. Factor loadings were calculated from the measurement model specified in the path analysis. All factor loadings were significant, and the average factor loading was .67 ($p < .001$). Table 3 shows the correlation matrix computed from raw data for each of the variables used in the path analysis. The correlation matrix among the latent variables in the path analysis is presented in Table 4. The resulting model and the significant path coefficients are presented in Figure 3. Unidirectional arrows extending from each determining variable to each variable dependent on it represent the causal associations or paths. Latent variables are also represented in Figure 3 and indicate the variance explained by measurement model.

Effects on hope concerning climate change

Table 5 provides an overview of the direct and indirect effects on hope concerning climate change and other endogenous variables. All variables were specified in the model to directly affect hope concerning climate change. The following variables had significant direct effects on hope: gender (−.08, $p < .05$), concern about climate change (.31, $p < .001$), and BE (.75, $p < .001$). The model specified that gender, grade level, opportunities to learn about practice, knowing people, own forests, race, and concern about climate change indirectly affect hope. The variables with significant indirect effect are grade level (.12, $p < .001$), opportunities to learn about practice (.10, $p < .05$), knowing people (.10, $p < .05$), and concern about climate change (.21, $p < .05$). The indirect effects of grade level and concern about climate change on hope were primarily mediated by being effective, with the effects of (.15, $p < .001$)

Table 2. Means, standard deviations, range, and factor loadings for the scales and subscales of the observed variables and latent variables.

Statements	Range	Mean	SD	Factor loadings
Model building (MB)	0–3			
Understanding of CC is caused mostly by human activities		.31	.46	.41
Understanding of the effects of human-caused CC have already begun to happen		.74	.44	.83
Understand that scientists believe that CC is happening		.80	.40	.55
Being effective (BE)	4–28			
I believe that people will be able to fix CC		3.99	1.5	.50
I believe that research and technical solutions will help fix CC		4.57	1.5	.56
Forest landowners can make a difference in the climate by practicing good forest management strategies		5.26	1.3	.67
Because people can change their behavior, we can influence CC in a positive direction		4.85	1.5	.72
Meaningful action (MA)	4–20			
Middle/high school students can help address CC		3.15	1.2	.53
Farmers can help address CC		3.92	1.0	.84
Forest landowners can help address CC		4.12	1.0	.91
Scientists can help address CC		4.46	.9	.69
Hope	3–21			
I am hopeful about resolving climate change because more people are taking CC seriously		4.41	1.4	.55
I know that there are a number of things that I can do to contribute to CC solutions		4.95	1.5	.82
I am hopeful about CC because I can think of many ways to resolve this problem		4.12	1.4	.77
Demographic	–			
Gender		.51	.50	–
Grade level		.64	.48	–
Race		.34	.58	–
Context	0–3			
Opportunities to learn about practice		.42	.49	–
Know people		.27	.44	–
Own forests		.75	.89	–
Concern about CC	1–4			
Concern		1.22	.83	1.00

Notes: All factor loadings are significant, $p < .001$; statistical significance is at 5% level.

Table 3. Correlation matrix used in the path analysis.

	Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1.	Gender	1.0000																				
2.	Grade	.00	1.000																			
3.	Oppor	.01	.04	1.00																		
4.	Kpeople	.02	−.07	.38	1.00																	
5.	Own	.03	−.12	.31	.30	1.00																
6.	Race	.07	.21	−.02	−.04	−.10	1.00															
7.	Concern	−.07	.03	.08	.11	.00	.11	1.00														
8.	MB1	−.05	.05	.02	.01	−.04	−.01	.14	1.00													
9.	MB2	−.11	.12	.05	.01	−.10	−.03	.31	.30	1.00												
10.	MB3	−.08	.08	.03	.01	−.07	−.02	.20	.20	.45	1.00											
11.	BE1	−.02	.09	.07	.04	−.03	−.04	.16	.11	.26	.17	1.00										
12.	BE2	−.02	.10	.07	.05	−.03	−.04	.18	.13	.28	.19.24	.62	1.00									
13.	BE3	−.03	.12	.09	.06	−.03	.05	.22	.16	.35	.24	.31	.35	1.00								
14.	BE4	−.03	.13	.10	.07	.04	−.06	.25	.17	.39	.26	.35	.39	.48	1.00							
15.	Hope1	−.06	.05	.07	.06	.00	.01	.28	.09	.21	.14	.20	.22	.28	.31	1.00						
16.	Hope2	−.09	.08	.09	.09	.00	.01	.41	.14	.31	.21	.29	.32	.40	.45	.44	1.00					
17.	Hope3	−.08	.07	.09	.08	.00	.01	.38	.13	.29	.19	.27	.30	.37	.41	.41	.59	1.00				
18.	MA1	−.08	.02	.05	.04	.04	−.02	.15	.05	.12	.08	.16	.17	.21	.24	.16	.23	.21	1.00			
19.	MA2	−.13	.03	.08	.05	.07	−.03	.24	.08	.19	.13	.24	.27	.33	.37	.25	.36	.33	.45	1.00		
20.	MA3	−.14	.04	.09	.06	.08	−.03	.26	.09	.21	.14	.26	.29	.36	.40	.27	.39	.36	.49	.76	1.00	
21.	MA4	−.11	.03	.07	.05	.06	−.02	.20	.07	.16	.11	.20	.22	.28	.31	.21	.30	.28	.37	.58	.63	1.00

For gender, 1 = male, 0 = female. Grade = grade level, 0 = 9th and 10th, 1 = 11th and 12th. Oppor = opportunity to manage forests. Kpeople = know people managing forests. Own = Own forests. Race, 0 = white, 1 = other. Concern = concern about climate change, 0 = not at all, 1 = a little, 2 = a fair amount, 3 = a lot. Correlations greater than .10 are significant at $p < .05$.

Table 4. Correlations matrix among latent variables in the path analysis.

	MB	BE	MA	Hope	Concern
MB	1.00				
BE	.65	1.00			
MA	.28	.59	1.00		
Hope	.44	.76	.53	1.00	
Concern	.34	.36	.30	.53	1.00

Note: Correlations greater than .10 are significant at $p < .05$.

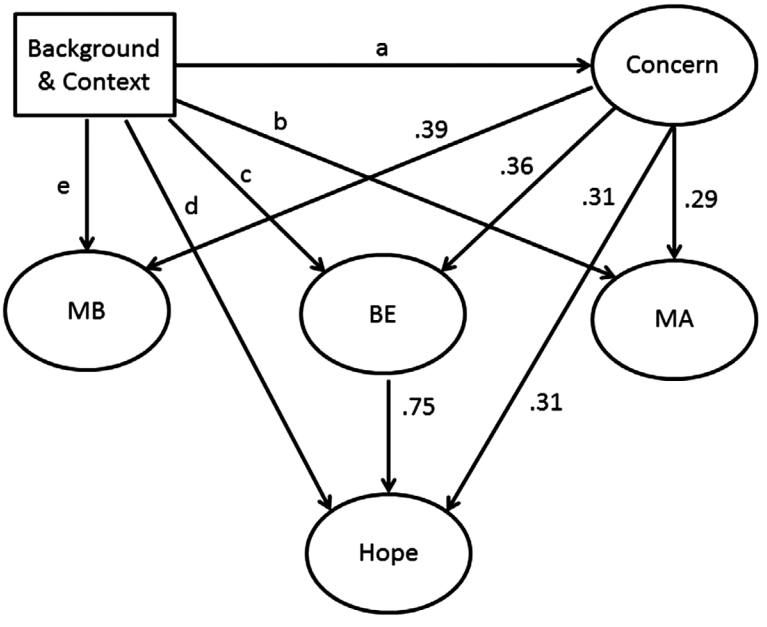

Figure 3. Standardized parameter estimates of model showing the relationships between concern, MB, BE, MA, and hope (concern = concern about climate change, MB = mental building, BE = being effective, MA = meaningful action, hope = hope concerning climate change. Omitted the relationship between background observed variables and non-significant paths for clarity. Statistical significance is at 5% level. a = gender −.08, know people .11, race 12; b = gender −.15, know people .04; c = grade level .21, opportunities = .12, race = −.12; d = gender −.11, grade level .10, opportunities .10, know people .10; e = grade level .18. The figure was generated by using Onyx V0.1 sofware, by von Oertzen, Brandmaier, and Tsang (2012)).

and (.26, $p < .001$), respectively. The indirect effect of opportunities to learn about practice on hope was mediated significantly by being effective, with the effect of (.07, $p < .05$). The indirect effect of knowing people who manage forests was primarily mediated by concern (.03, $p < .05$). The indirect effect of gender was primarily mediated by concern (−.03, $p < .05$). The variables with significant total effects on hope are gender (−.11, $p < .05$), grade level (.10, $p < .05$), opportunities to learn about practice (.10, $p < .05$), knowing people (.10, $p < .05$), concern about climate change (.52, $p < .001$), and being effective (.75, $p < .001$). The results indicate that being female and older, having opportunities to learn about practice strategies, and knowing people who manage their forests lead to greater hopefulness. The association between concern and hope is positive, which indicates that students who have greater concern about climate change also have greater hope.

Effects on model building, being effective and meaningful action

Model building

The hypothesized model specified the demographic variables and concern about climate change directly affect MB. The data suggest that, however, the only variable with significant direct effect on

Table 5. Standardized total, direct and indirect effects of the variables under investigation.

Effect	Direct	Indirect	Total
On hope			
Of gender	−.08*	−.03	−.11*
Of grade level	−.02	.12***	.10*
Of opportunities	−.01	.10*	.10*
Of know people	.00	.10*	.10*
Of own forests	.02	−.07	−.05
Of race	.05	−.04	.01
Of concern	.31***	.21***	.52***
Of MB	−.14	–	−.14
Of BE	.75***	–	.75***
Of MA	.03	–	.03
On MB			
Of gender	−.07	−.04	−.11
Of grade level	.18**	.00	.18**
Of opportunities	.04	.02	.06
Of know people	−.04	.04*	.00
Of own forests	−.12	−.01	−.13
Of race	−.11	.04*	−.07
Of concern	–	–	.39***
On BE			
Of gender	.01	−.03*	−.02
Of grade level	.21***	.00	.21***
Of opportunities	.09	.03	.12*
Of know people	.04	.04*	.08
Of own forests	−.09	−.01*	−.10
Of race	−.16**	.04**	−.12**
Of concern	–	–	.36***
On MA			
Of gender	−.12**	−.03*	−.15**
Of grade level	.06	.00	.06
Of opportunities	.04	.02	.06
Of know people	.01	.03*	.04*
Of own forests	.06	−.01	.05
Of race	−.05	.03*	−.02
Of concern		–	.29***
On concern			
Of gender	−.08*	–	−.08*
Of grade level	.01	–	.01
Of opportunities	.05	–	.05
Of know people	.11*	–	.11*
Of own forests	−.03	–	−.03
Of race	.12**	–	.12**

*$p < .05$; **$p < .01$; ***$p < .001$.

model building is grade level (.18, $p < .05$). The variables with significant indirect effects on model building are knowing people who manage their forests (.04, $p < .05$) and race (.04, $p < .05$). The indirect effect of knowing people who manage their forests and race on model building was significantly mediated by concern. The variables with significant total effects on MB are grade level (.18, $p < .01$) and concern about climate change (.39, $p < .001$). This result indicates that older students and students who have higher level of concern about climate change tend to have greater knowledge and understanding on causes and impacts of climate change.

Being effective

The hypothesized model specified that demographic variables and concern about climate change directly affect BE. The data suggest, however, that variables with significant direct effects on being effective are grade level (.21, $p < .001$) and race (−.16, $p < .01$). The variables with significant indirect effects on being effective are gender (−.03, $p < .05$), knowing people (.04, $p < .05$), own forests (−.01, $p < .05$), and race (.04, $p < .01$), respectively. The indirect effects of gender, knowing people, own forests,

and race on being effective were mediated by concern. The variables with significant total effects on being effective are grade level (.21, $p < .001$), opportunities to learn about practice (.12, $p < .05$), owning forests (–.10, $p < .05$), race (–.12, $p < .01$), and concern about climate change (.36, $p < .001$). The results indicate that being female and older and having opportunities to learn about practice lead to greater BE. The association between concern and BE is significant, which indicates that BE is a significant mediator between environmental concern and hopefulness. Students who have greater concern about climate change also have greater hopefulness if they believe that society and themselves have the skills to solve the problem.

Meaningful action

The variable with significant direct effects on MA is gender (–.16, $p < .01$). The variables with significant indirect effects on MA are gender (–.03, $p < .05$), knowing people (.03, $p < .05$), and race (–.03, $p < .05$). The indirect effects of gender, knowing people, and race were mediated by concern. The variables with significant total effects on MA are gender (–.15, $p < .05$), knowing people (.04, $p < .05$), and concern about climate change (.29, $p < .05$). The results suggest that being female and knowing people who manage their forests lead to stronger belief that there are actions people can take to make a difference. Students who have greater concern about climate change tend to also have a stronger belief that there are meaningful actions people can take to solve problems caused by climate change.

Effects on concern about climate change

The hypothesized model specified that gender, grade level, opportunities to learn about practice, knowing people, own forests, and race directly affect concern about climate change. The variables with significant direct effect on concern about climate change are gender (–.08, $p < .05$), knowing people (.11, $p < .05$), and race (.12, $p < .01$), indicating that being female, and non-white, and knowing people who manage forests lead to greater concern.

Associations between latent variables

Correlation analysis between latent variables (Hope, MB, BE, MA, and Concern) indicates that all latent variables significantly correlate with each other (see Table 4). The associations are positive from .28 (between MA and MB) to .76 (between Hope and BE). The effects magnitude is moderate at statistical significance 5% level. An increase in MB, BE, MA, and Concern will result in the increase in hope. However, the correlation analysis could not verify there is a causal relationship between the variables. We cannot interpret that the increase in MB, BE, MA, and Concern is the cause of increase in hope.

The results of this study provided empirical evidence to support hypothesis 1, 2, and 3. Students are more likely to be hopeful if they: (1) have more knowledge and are able to make sense of the causes of climate change; (2) believe that human society have ability to solve the problem; and (3) perceive that there are actions the people can take to make a difference. Environmental concern is a predictor and a mediator that associated with MB, BE, MA, and hope (Figure 3). The model with demographic context variables yield a better model fit result.

Discussion

This study examined the relationships between hope concerning climate change, model building, meaningful action, being effective, and concern about climate change when controlling for demographic and context variables. Specifically, this study supports the RPM framework (Kaplan and Kaplan 2009) that model building, meaningful action, and being effective are significant correlates with hope (Table 4). Based on the path analysis, being effective is the only component that has a significant direct path to hope when controlling for demographic and context variables, which indicates that there is causal relationship between being effective and hope agency and pathway thinking. Students who believe

that society and laypeople have ability and skills to undertake actions are more likely to be hopeful. This finding shows consistency in a recent study which revealed that skills building combined with a socially supportive setting foster informal science educators' hope and engagement in discourse about climate change (Swim and Fraser 2013).

Our results suggest that the association between concern and hope is positive, and indirectly influenced by a variety of factors. Young people who are strongly concerned climate change may also experience a higher degree of hope; perhaps greater concern helps trigger great attention to gaining information and examples and finding strategies to be effective (BE). If educational or outreach programs can increase the students' competence as well as concern level, it is more likely that hopefulness about climate change will increase. For example, educators could use an activity to engage students in creating a timeline of climate science and policy initiatives over the past two centuries, students will explore and review the connections between the carbon dioxide, climate change, and impact on forest ecosystems. This activity will raise students' awareness and concern level. To increase students' sense of competence, a follow up activity could be used to initiate a discussing about how different climate scenarios could affect forests and how management options may help the forest thrive (Monroe and Oxarart 2014).

Gender and age have significant small total effects on hope, with female and higher grade (11th and 12th) having greater hopefulness. Contextual variables, such as opportunities to learn about forest management practices and knowing people who work in forestry, affect hope indirectly through being effective. In this context, this information provides examples of feasible strategies. These results indicate that female and older students have a different baseline hopefulness than male and younger students although the magnitude is very small. This raises an interesting research question about how gender and grade level affect changes in hopefulness. Similarly, more research is needed to assess whether some educational strategies are more effective for students who do not yet have opportunities to learn about practice or experience in forest management.

In addition, the path analysis indicated that model building (MB) – knowing climate change is happening and understanding human activities are impacting climate system – was only correlated with hope, but was not a significant path to hope, unlike the element of concern. Consistent with existing research evidence, there is no causal relationship between understanding the issue and hope. Knowledge alone is not sufficient to promote positive attitude, efficacy, and environmental engagement (Ajzen 1985; Bandura 1997; Hines, Hungerford, and Tomera [1986] 1987). Perceiving that there are actions students and people can take significantly correlates with hope (MA), yet was also not found to be a significant path to hope. In the context of solving environmental issues, perhaps this is a function of the scale of the problem. Climate change is often perceived to be beyond the individual's influence. Perceiving that there are actions respondents can take will build more hope when they also trust and believe that society and others have the ability and are willing to take actions.

This study provides useful insights in how to design programs to foster hope regarding climate change. Programs should be able to significantly increase hopefulness if they foster sense of efficacy through providing imagery of what others are doing at both personal and community level. The details of climate science and understanding of the issue, however, may help affect concern, but may only increase hope if paired with a variety of potential actions and solutions to help foster students' hope agency and pathways thinking at personal and community level.

Future research could apply the findings to the development of strategies to measure hope. We assume that a sense of hopefulness consists of personal and collective efficacy, which includes personal and collective willpower and waypower to address problems caused by climate change (Snyder 1994). What is more, additional inquiry might apply strategies that can build self-efficacy to design and measure the potential change of a climate change educational program with increasing students' hopefulness as a learning outcome. Beyond this, we suggest comparing the results from girls and boys, among various grade levels, and with people who come from forested area and non-forested area. Future study could also look at the tipping point of concern about climate change and hopefulness. The literature suggested that environmental concern have a positive correlation with hope because it

measure the extent to which people care about the issue. On another hand, environmental grief could lead to disengagement if they feel they cannot make a difference or their personal actions do not matter. Can negative information overload lead people to disengage? In other words, can too much concern decrease hopefulness or even lead to hopelessness? How do researchers find and quantify the balance in between being concerned and overwhelmed? An experimental study exploring the point of diminishing returns with the relationship between concern and hope could be useful.

This work contributes to the literature that explores how to predict and nurture hopefulness regarding climate change by applying one of the environmental psychology frameworks – the RPM. The model incorporates constructs not only from RPM but also demographic and context variables, such as opportunities to learn about practice and knowing people from the community who are managing the forests to mitigate climate change. Our findings suggest that the efficacy belief that individuals and society are able to make a difference in addressing climate change leads to hopefulness. Despite the fact that students recognize the causes and impacts of climate change, their sense of hopefulness will be constrained unless they recognize that effective changes can be made at personal and community level. Educators can create supportive learning environments to nurture hope by providing images of others caring and doing things at both personal and community level in addition to providing climate science information. It is crucial that educational programs provide opportunities for students to see the connections, examples, and local practices that enable individuals and communities to solve problems caused by climate change. Future research could test the effectiveness of using these strategies to design educational and outreach programs.

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Appendix 1. Survey items for path analysis

Hope concerning Climate Change (Hope)

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

Being Effective (BE)

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 believe people will be able to fix climate change.	1	2	3	4	5	6	7
2.	I believe that research and technical solutions will help fix climate change.	1	2	3	4	5	6	7
3.	Forest landowners can make a difference in the climate by practicing good forest management strategies.	1	2	3	4	5	6	7
4.	Because people can change their behavior, we can influence climate change in a positive direction.	1	2	3	4	5	6	7

Meaningful Actions (MA)

How much can each of the following types of people help address climate change?

(1=nothing; 2=a little; 3=unsure; 4=some; 5=a lot)

1.	Middle/high school students	1	2	3	4	5
2.	Farmers	1	2	3	4	5
3.	Forest Landowners	1	2	3	4	5
4.	Scientists	1	2	3	4	5

Model Building about Climate Change (MB)

1. Do you believe increases in the Earth's temperature over the last century are due mostly to:

a. The effects of pollution from human activities
b. Natural changes in the environment not due to human activities
c. Both natural and human activities equally

2. When do you think the effects of human-caused global warming will begin to happen?

a. They have already begun to happen
b. They will start happening within a few years
c. They will start happening within my lifetime
d. They will not happen within my lifetime, but they will affect future generations
e. They will never happen

3. Which statement do you think is the most accurate?

a. Climate scientists do not believe that climate change is occurring
b. Climate scientists believe that climate change is occurring
c. Climate scientists are unsure about whether or not climate change is occurring

Concern about Climate Change (concern)

How much do you personally worry about climate change?

a. A great deal
b. A fair amount
c. Only a little
d. Not at all

Demographic Variables

1. I am: ☐ Male ☐ Female
2. I am: ☐ Hispanic/Latino ☐ Not Hispanic/Latino

3. 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) _____

4. What is your grade in school?

- ☐ 9th
- ☐ 10th
- ☐ 11th
- ☐ 12th

5. How many forested acres does your family own?

- ☐ None
- ☐ Less than 5 acres
- ☐ 6- 100 acres
- ☐ More than 100 acres

6. Are there any opportunities for you to learn about forest management practices?

- ☐ Yes, with my family.
- ☐ Yes, with my school.
- ☐ No, but I would like to learn more about it.
- ☐ No, and I am not interested.

7. Do you know people who manage forests?

- ☐ Yes, my family.
- ☐ Yes, my neighbors.
- ☐ Yes, people in the area.
- ☐ No.