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Students' climate change emotions, attitudes, and self-efficacy in the Czech Republic, Slovakia, and Hungary

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ABSTRACT

Climate-related emotions, attitudes, and self-efficacy are increasingly recognized as interlinked drivers of adolescents' pro-environmental behavior, yet evidence on their joint role across cultural contexts remains limited. This study explores the interplay between climate-related emotions, attitudes, and pro-environmental behaviors among secondary school students from the Czech Republic, Slovakia, and Hungary. It is based on previous studies focused on eco-anxiety, eco-guilt, and environmental hope of students in various countries, as well as research investigating the factors influencing human pro-environmental behavior. Collecting data from 17-year-old students in October 2022 ($N = 6{,}477$), it analyzed the role of climate-related emotions in shaping students' behaviors and actions. Based on the findings, while eco-anxiety and climate change attitudes were linked to habitual pro-environmental behaviors (e.g. recycling, energy conservation), their impact on deliberate pro-environmental actions was indirect, mediated by environmental self-efficacy and eco-guilt. Environmental self-efficacy emerged as the strongest predictor of pro-environmental behavior. While girls exhibited a higher level of almost all emotions than boys, country differences had no practical significance. Based on these findings, the study emphasizes the importance of fostering students' environmental self-efficacy and equipping them with coping strategies with climate-related emotions.

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Introduction

The rapid development of climate change brings consequences for children's emotional stability. Negative emotions, like eco-anxiety, eco-guilt, eco-grief, self-blame, or others, are experienced by youth all over the world (Baker, Clayton, and Bragg 2021; Diffey et al. 2022; Ramadan et al. 2023). These emotions underscore the psychological burden of particularly vulnerable adolescents (Coffey et al. 2021; Ojala 2015; Pihkala 2020), e.g. 10-19-year-old children (WHO, 2020n.d.). According to Hickman et al. (2021), more than 50% of young people all over the world feel sadness, hopelessness, anxiety, despair, guilt or self-blame when they think about climate change. At the same time, emotions are critical for young people's motivation to engage in environmental actions or participate in individual pro-environmental behavior (Dunlop and Rushton 2022). However, the nature of the impact of these emotions is still a matter of discussion. Despite the number of existing studies, there is still a need for comprehensive research to understand the relationship between eco-anxiety and other climate-related emotions and pro-environmental behavior (Coffey et al. 2021).

This article brings a comparative, international perspective of the relationship between climate change attitudes, feelings, and pro-environmental behavior of adolescents in three countries – Czechia, Hungary, and Slovakia.

Eco-anxiety, eco-guilt, and hope as emotional reactions to environmental degradation and climate change

Eco-anxiety

Eco-anxiety is defined as a particular type of stress and worry that is related to the ecological crisis (Ágoston et al. 2022b). It is driven not only by the personal experience of environmental loss but also by awareness of the ongoing and future impacts of climate change, the anticipation of future risks, or the perceived gravity of climate change (Clayton 2020; Ojala 2016). Eco-anxiety is closely linked with other emotions such as fear, grief, terror, guilt, anger, and despair. These emotions often overlap and can vary in intensity. If not managed, they may cause psychological distress, leading to insomnia, depression, panic attacks, or feelings of hopelessness (Dunlop and Rushton 2022; Gago and Sá 2021; Hickman 2020; Pihkala 2020; Wang et al. 2023).

Eco-anxiety may be further characterized in terms of its intensity and components. Hickman (2020) identified four levels of intensity of eco-anxiety: mild eco-anxiety involves occasional upset, medium eco-anxiety sees more frequent distress, significant eco-anxiety brings daily distress, minimal defenses against guilt and fear, and severe eco-anxiety leads to overwhelming terror, intrusive thoughts, and extreme actions. According to Pihkala (2022), only the strongest forms of eco-anxiety can be seen as a problem, as the milder forms can be considered healthy reactions to environmental threats and loss.

Ágoston et al. (2022b) and Soutar and Wand (2022) identified various components of eco-anxiety, including worries about the future and the next generations, empathy for suffering populations, conflicts arising from differing views on climate action, disturbances caused by environmental changes, mental health symptoms, and feelings of helplessness. Many studies reflect the increasing level of eco-anxiety across various

demographic groups, including children and students (Baker, Clayton, and Bragg 2021; Gago and Sá 2021; Hiser and Lynch 2021; Marks et al. 2022).

Eco-guilt

Eco-guilt is a specific form of guilt people experience when they do not meet personal or societal environmental standards or feel they harm the environment by their actions or inactions. It often manifests as a perceived moral responsibility towards the environment and its degradation (Ágoston et al. 2022b; Dunlop and Rushton 2022; Hiser and Lynch 2021; Pihkala 2020). Ágoston et al. (2022b) identified more types of eco-guilt, including maladaptive forms like guilt for one's existence, which may lead to paralysis and inaction. The various ways of experiencing guilt can significantly influence whether it leads to constructive behavior change or contributes to eco-paralysis. Feelings of guilt and shame are prominent among those aware of the environmental crisis, particularly when considering their contributions to the problem or their relative inaction (Hickman 2020).

The effect of eco-anxiety and eco-guilt on pro-environmental behavior

Both eco-anxiety and eco-guilt can shape pro-environmental behavior, but their effects appear ambivalent and may depend on the type of behavior being examined. Pro-environmental behavior ranges from low-cost, routine habits (e.g. recycling, switching off lights) to more effortful and deliberate actions (e.g. actively changing consumption patterns, participating in environmental initiatives). This distinction is important because eco-anxiety and eco-guilt may relate differently to habitual pro-environmental behavior (PBH) than to intentional pro-environmental actions (PBA). According to Coffey et al. (2021), while these emotions can lead to a sense of hopelessness and inaction, they can also serve as a psychological adaptation and motivate individuals towards active engagement and pro-environmental behavior when coupled with positive emotions like hope and empowerment.

Eco-guilt can lead to constructive behavior changes and can spur corrective actions. It may therefore be more closely aligned with intentional actions (PBA), where individuals make conscious decisions to 'do something' to reduce harm. However, excessive guilt may also lead to emotional burnout and paralysis, where individuals feel too overwhelmed to act (Sanson, van Hoorn, and Burke 2019; Soutar and Wand 2022). Most of the authors argue that a certain level of eco-anxiety, when appropriately managed, can motivate individuals to engage in behaviors that help mitigate environmental damage (Ágoston et al. 2022b; Clayton 2020; Clayton and Karazsia 2020; Dunlop and Rushton 2022; Hiser and Lynch 2021; Sanson, van Hoorn, and Burke 2019). In this respect, eco-anxiety may contribute to strengthening climate-related concern and supportive attitudes, which could be more directly reflected in habitual behaviors (PBH) that are consistent with everyday norms and routines.

According to Maran and Begotti (2021), climate anxiety (e.g. eco-anxiety related to climate change) positively relates to efficacy beliefs. When paired with a strong sense of efficacy, climate anxiety can motivate individuals to take constructive actions toward mitigating climate change. For example, people who report experiencing eco-anxiety are often more likely to adopt sustainable practices and engage in

environmental advocacy (Clayton 2020). Based on this, a moderate level of eco-anxiety may motivate one to reduce individual actions with negative ecological impacts. It corresponds with Ojala (2016), who claims that worry/anxiety could be a first step towards taking climate protection action, but that the translation of worry/anxiety into behavior may differ across PBH and PBA depending on whether individuals perceive realistic pathways to act.

Coffey et al. (2021) argue that different eco-emotions, such as eco-anxiety, eco-depression, and eco-anger, impact climate action differently. For instance, eco-anger is associated with greater engagement in collective pro-environmental behaviors, while eco-anxiety is less adaptive and tends to predict lower participation in collective actions. However, other authors question the possibly positive effects of eco-anxiety. According to Clayton and Karazsia (2020), while climate change anxiety is correlated with negative emotions, it is not directly correlated with behavioral engagement, suggesting that anxiety alone does not necessarily motivate either PBH or PBA. Diffey et al. (2022) argue that negative climate-related feelings significantly disrupt the daily lives of young people, affecting their ability to relax, sleep, study, or work. The lack of support for managing these emotions can lead to additional distress, making it harder for them to engage in constructive pro-environmental actions. According to Chawla (2020), despair and helplessness are negatively related to action.

Furthermore, other authors emphasize the significance of the temporal aspect. While short-term anxiety can facilitate motivation toward positive action, long-term anxiety may lead to burnout and overall demotivation (Ferguson, Branscombe, and Reynolds 2011; Cunsolo and Ellis 2018). According to Norgaard (2011), continuous anxiety can lead to psychological denial and apathy, reducing motivation to engage with environmental issues over time. Similarly, Clayton (2020) argues that while a short-term anxiety may encourage protective behaviors, a chronic anxiety can impair mental health and lead to burnout, negatively affecting long-term motivation.

It could be assumed that eco-anxiety, eco-guilt, and other negative feelings are a double-edged sword: they can lead to paralyzing emotions and feelings of hopelessness, but they can also motivate to action (Soutar and Wand 2022; Wang et al. 2023). Pihkala (2020) differentiates between 'practical anxiety' (which motivates action) and 'paralyzing anxiety' (which hinders action). Most authors argue that the crucial factor for prevailing one of these forms of anxiety is the way the negative feelings are managed (Hiser and Lynch 2021; Verlie et al. 2021; Wang et al. 2023).

Coping strategies for dealing with eco-anxiety or eco-guilt

Various coping strategies for dealing with eco-anxiety or eco-guilt have been identified (Ramadan et al. 2023; Soutar and Wand 2022). Pihkala (2022) argues that individuals experiencing the ecological crisis go through stages from initial unawareness, awakening, and shock to coping and change. In the coping phase, three dimensions—action (pro-environmental behavior), grieving (emotional engagement), and distancing (including both self-care and problematic denial)—are crucial. Difficulties in any of these dimensions can hinder effective adaptation and action.

Ojala (2012) identified three types of coping mechanisms for climate-related anxiety: problem-focused coping, which involves taking concrete actions to address environmental issues; emotion-focused coping strategies, such as distancing and

deemphasizing the seriousness of climate change; and meaning-focused coping, based on reappraising the situation positively and placing trust in societal actors to address climate change. Based on her research, younger children use emotion-focused coping strategies more commonly than older adolescents and young adults. In contrast, the other two coping strategies are more common among adolescents and young adults. Deemphasizing the problem was negatively associated with pro-environmental behavior, whereas problem-focused and meaning-focused coping was positively associated with pro-environmental behavior (Ojala and Bengtsson 2019).

Ágoston et al. (2022b) categorized six coping mechanisms related to eco-anxiety, eco-guilt, and eco-grief, including taking action or confronting others, positive reappraisal, withdrawal, and seeking social support. Problem-focused and social support strategies were generally more adaptive, fostering well-being and pro-environmental behavior, whereas some emotion-focused strategies might lead to avoidance or denial. Similarly, Baker, Clayton, and Bragg (2021) found that children often respond to climate-related stress through personal actions, such as changing individual behaviors, participating in climate strikes, or communicating concerns.

Gago and Sá (2021) found that problem-solving, emotional expression, and wishful thinking were among the main coping strategies used by adult university students. However, these coping strategies did not moderate the relationship between environmental worry and symptoms.

Lertzman (2015) suggests that acknowledging and expressing emotions like anger can facilitate engagement and reduce feelings of helplessness and anxiety. According to Adams (2014), the active engagement with emotions, such as anger, can motivate individuals to take action against environmental degradation, and, as a result, reduce eco-anxiety by providing a sense of agency and empowerment.

The effectiveness of coping strategies of young people may be positively influenced by positive, solution-oriented communication patterns with friends and parents (Ojala and Bengtsson 2019), pro-environmental action balanced with emotional engagement and self-care (Pihkala 2020; Soutar and Wand 2022), and hope. It is also affected by media exposure to climate change information and an environmental identity and connection with nature in childhood, which may foster a commitment to environmental stewardship (Chawla 2020; Clayton and Karazsia 2020; Maran and Begotti 2021).

Environmental hope

Environmental hope was defined as individuals' beliefs of being able to generate plans and execute them with the goal of environmental protection, thus helping us to understand the cognitive pathways and level of agency thinking that students possess in this study. Snyder et al. (1991) distinguishes an agency component ('I will' beliefs) from a pathways component ('I can' beliefs). While the impact of eco-anxiety and guilt on pro-environmental behavior seems to be conditioned by how the coping mechanisms manage it, the role of hope in promoting willingness to act seems unopposed. Hope is seen as an essential element in sustaining long-term motivation for pro-environmental behavior. It is also considered to be crucial for maintaining mental health and coping with negative environmental feelings leading to paralysis, despair, and hopelessness (Diffey et al. 2022; Dunlop and Rushton 2022; Hickman 2020; Hiser and Lynch 2021; Klocker et al. 2023; Ojala 2012). Hope could be promoted

by positive reappraisal, fostering a sense of efficacy, promoting trust in societal actors, or participation in concrete actions (Marks et al. 2022; Ojala 2012; Ramadan et al. 2023; Soutar and Wand 2022). Ojala highlights the importance of constructive hope, i. e. the hope not based on blind wishful thinking but reflecting the severity of climate change issues (Ojala 2016). Such hope should balance the realism in reflecting the crisis with optimism to prevent students' disengagement and keep motivation to meaningful actions (Baker, Clayton, and Bragg 2021; Marks et al. 2022; Verlie et al. 2021; Wang et al. 2023).

Country and gender differences

While negative feelings about the state of the environment are spread all over the world, their intensity differs among the countries. Ogunbode et al. (2022) found relatively significant differences between the level of climate anxiety of adults ranging from countries with a relatively high level of anxiety (e.g. Brazil, Spain, Philippines) and oil-producing countries on the opposite side of the spectrum (e.g. Russia, Oman, Nigeria). Further differences were found by Leiserowitz et al. (2021), who compared climate-related feelings and beliefs of more than thirty countries. In their survey, more than 80% of respondents from countries like Mexico or Vietnam believed climate change would be personally harmful, compared with less than 30% of respondents from the Netherlands or the Czech Republic. In addition, prior research frequently reports gender differences in climate-related emotions and concern, with girls often reporting stronger eco-emotions and higher perceived seriousness of climate change (e.g. Coffey et al. 2021; Elert and Lundin 2022; Pickering and Dale 2023); however, stronger emotional engagement does not necessarily imply higher behavioral engagement, particularly for intentional action, which may depend on efficacy beliefs and perceived agency.

Cultural context

Although the Czech Republic, Slovakia, and Hungary are neighbouring countries with shared history, their policy trajectories and public discourses on climate change have evolved in distinct ways. The following section provides a descriptive overview of selected research findings on climate-related beliefs in each country, rather than a systematic comparative analysis.

The initial skepticism of Czech citizens about human impact on climate have developed recently and today, with a gradual decrease of climate skeptics to approximately only 10% of the adult population (Akademie věd České Republiky 2020; Chabada 2018; CVVM 2020; Krajhanzl, Chabada, and Svobodová 2018; Leiserowitz et al. 2021, 2022). Nevertheless, Czech citizens are among the least alarmed about climate change worldwide (Leiserowitz et al. 2021, 2022), they tend to question the usefulness of climate-relevant actions, and they do not believe in their capacity to promote climate protection (Činčera and Kroufek 2021; Krajhanzl, Chabada, and Svobodová 2021; Lehnert et al. 2019). Based on recent studies, a lot of Czech adolescents perceive emotions like extreme powerlessness, fear, sadness, or depression. More than 80% of respondents to the survey conducted on the sample of $N = 218$

15-20-year-old students expressed their belief in the seriousness of climate change (Krajhanzl, Chabada, and Svobodová 2021). Czech students tend to be skeptical about the usefulness of climate protection actions. However, secondary school students, particularly girls, are more willing to be engaged in climate protection behavior and less skeptical towards climate protection actions than upper-primary school students (Jurek et al. 2022; Lehnert et al. 2019).

The vast majority of Hungarian citizens is aware of climate change and its human origin. About 90% of Hungarians accept the scientific consensus that the global climate is warming as the consequence of human activities (Surányi 2024, Bodor et al. 2024). On the other hand, only one third of Hungarians put climate change amongst the four most significant global challenges (Special Eurobarometer 538 538 2023). A special characteristic of the Hungarian population is that serious climate concerns are co-existing with a low feeling of personal responsibility and a low level of trust in other people's commitment to take actions against climate change (Grünhut, Varjú, and Bodor 2023). According to a representative national survey sponsored by UNICEF Hungary (2025), 90% of young Hungarian people experience some degree of anxiety about climate change, and 33% are extremely anxious. The research also revealed that for 35% of young people, climate change is the most pressing problem, while 21% consider it the second most important. The feeling of helplessness is also substantial: 53% of young people feel helpless about the climate crisis. This feeling often accompanies the desire to do more and the lack of knowledge about possible actions. 84% of respondents feel they would like to receive more knowledge about climate change and sustainability at school, which points to the education system's shortcomings in this area (UNICEF. 2025). Another recent research found that most of the interviewed young Hungarian people believe that climate change aspects should also be considered when making decisions about having children (Bognár 2025).

According to a national survey by Chabada et al. (2022) and a regional survey by Tóth, Šebová, and Liptáková (2020) more than three-quarters of the Slovak residents are convinced of the existence of climate change, and anthropogenic cause of climate change. A large number of people also experience strong to extreme unpleasant climate-changed related feelings (worries, helplessness, fear), and some report extreme depression (Chabada et al. 2022). According to a recent Eurobarometer (2024) survey, young Slovaks consider the issue of the environment and climate change to be important. This topic was identified as one of the key ones by 32% of respondents from Slovakia. Addressing climate change is not a matter of choice. A survey commissioned by the President's office by the Median (2021) showed that up to 42% of Slovaks aged 16 to 25 are very concerned about the impacts of climate change, and 73% of respondents aged 16 to 25 think that humanity has failed to care for the planet. More than 50% of them are disappointed in how politicians face the climate crisis and believe they betrayed future generations. In the survey of the non-profit organization CEEV Živica (2023) on the sample of 160 teachers, ten percent reported they experienced climate anxiety in their students.

Proposed model

Based on the sources presented in the Introduction section and other relevant literature, we hypothesized a model in which emotions and self-efficacy were predictors of

climate-related attitudes and pro-environmental behavior. Emotions such as eco-anxiety and eco-guilt are increasingly recognized as important predictors of environmental concern and action (Clayton and Karazsia 2020; Harth, Leach, and Kessler 2013) and they are believed to mobilize individuals toward pro-environmental behavior when accompanied by a sense of agency (Baumeister et al. 2007). Environmental self-efficacy, derived from Bandura's Bandura (1977, Bandura 1997) social cognitive theory, plays a crucial role in determining whether concern translates into action. Together, these constructs might influence both climate change attitudes and pro-environmental behavior, aligning with frameworks such as the Theory of Planned Behavior (Ajzen 1991) and the Value-Belief-Norm theory (Stern 2000). Recent research supports this emotion-efficacy-behavior pathway (Swim and Bloodhart 2015; van Zomeren, Spears, and Leach 2010).

The literature suggests that eco-anxiety and eco-guilt are not uniform predictors of pro-environmental behavior; rather, they can facilitate engagement or contribute to avoidance depending on whether adolescents perceive viable coping pathways and a sense of agency. This implies that the relationship between eco-emotions and behavior is likely to operate through cognitive–motivational mechanisms, particularly environmental hope and climate change attitudes. Climate change attitudes reflect endorsement of climate protection and perceived seriousness of the issue, which may support PBH through routine, low-cost practices consistent with daily norms. In contrast, PBA require greater effort and deliberation and may therefore depend more strongly on perceived efficacy and moral emotions such as eco-guilt. Accordingly, the present study conceptualizes students' climate-related engagement as an integrated system in which eco-anxiety, eco-guilt, hope, and attitudes jointly shape distinct forms of pro-environmental behavior. The study compares this framework in the Czech Republic, Hungary, and Slovakia and mainly it focuses on the following questions:

- What are the differences in climate change attitudes, eco-anxiety, eco-guilt, and hope between secondary school students in the Czech Republic, Slovakia, and Hungary?
- Are there significant differences between these attitudes, as well as in the level of students'environmental hope, eco-anxiety, and eco-guilt, among girls and boys or respondents from different countries?
- Is the hypothesized relationship between the investigated constructs (environmental hope, climate change attitudes, eco-anxiety, eco-guilt) and the participants' pro-environmental behavior (separately in the Czech Republic, Slovakia, and Hungary) confirmed by confirmatory modelling?

Materials and methods

Participants

The participants were students from Hungary, Slovakia, and the Czech Republic who agreed to participate in the study. To avoid age-related bias, only students in 10th-11th grade (17 years old, the grade system identical for all selected countries) were invited. All data were collected in October 2022. In the Czech Republic and Hungary, data were collected using a two-stage stratified random sampling design. Schools were selected with the support of national education authorities through a probability-proportional-to-size

procedure, and a unique survey link was assigned to each school. Within participating schools, one class was randomly selected to complete the questionnaire.

In Slovakia, a comparable stratified sampling approach was not feasible due to the lack of a comprehensive national database. Instead, regional education authorities were contacted and asked to distribute the survey link to secondary schools in their jurisdictions. In participating schools, one class was selected using the same within-school procedure as in the Czech Republic and Hungary.

To address differences in sampling design and deviations from population parameters, multivariate weighting was applied across all national datasets. Weighting variables included region, school type, and school ownership, thereby improving the overall representativeness of the samples. Students were informed about the research and could decide on their participation.

The final sample comprised 6477 respondents (see Table 1), 52% of boys and 48% of girls. To enable a clean separation between exploratory item selection and confirmatory validation, the Hungarian sample was randomly split in half into an exploratory half ($n = 1{,}917$) used for exploratory factor analyses, and a confirmatory half ($n = 1{,}915$) used for confirmatory factor analyses and measurement invariance testing alongside the Czech and Slovak samples.

The mean age was (M=) 16.73 years (SD = 0.71), with the Hungarian sample's mean being (M=) 16.89 (SD = 0.64), the Czech sample's being (M=) 16.53 (SD = 0.77) and the Slovakian sample's being (M=) 16.56 (SD = 0.65).

Data collection

The data were collected through an online questionnaire with several sections related to constructs described below, the data collection was fully anonymous (for the full wording of the items, see Appendix).

The scale for students' climate change attitudes (CCA) was adapted from Christensen and Knezek (2015). It encapsulates students' overall attitudes towards the need of climate protection and consists of eight items (e.g. Global climate change will change our environment in the next ten years, etc.) with Cronbach alpha ranging from $\alpha = 0.89$ (Czech sample) to $\alpha = 0.91$ (Hungarian sample); pooled $\alpha = 0.91$ across the three samples combined. The confirmatory factor analysis (CFA) provided evidence of reasonable model fit (Hu and Bentler 1999; MacCallum, Browne, and Sugawara 1996) for the structure across three translations (CFI ≥ 0.97, RMSEA ≤ 0.08, SRMR ≤ 0.03; see Table 2).

The eco-anxiety (EA) scale represents students' fear of environmental doom and was adapted from Ágoston et al. (2022a). It consists of four items (e.g. I am terrified by how many things have changed in just a few years because of climate change.) and its reliability ranges from $\alpha = 0.83$ (Slovak sample) to $\alpha = 0.92$ (Hungarian sample); pooled $\alpha = 0.90$ across the three samples combined. The single-factor model showed strong standardized loadings (0.71 to 0.92) and high incremental fit across the three samples; RMSEA values were elevated, a known limitation of RMSEA in models with small degrees of freedom (Kenny, Kaniskan, and McCoach 2015).

Table 1. Research sample.

	Hungary	Czechia	Slovakia
Boys	1806	844	711
Girls	1628	812	676

Table 2. Confirmatory factor analysis results – model fits.

	Hungary	Czechia	Slovakia
CCA	$\chi^2(19) = 196.48$, $p < .001$ CFI = 0.981; TLI = 0.973 RMSEA = 0.068 [.060, .077] SRMR = 0.021	$\chi^2(19) = 104.87$, $p < .001$ CFI = 0.978; TLI = 0.967 RMSEA = 0.067 [.055, .080] SRMR = 0.023	$\chi^2(19) = 99.76$, $p < .001$ CFI = 0.973; TLI = 0.961 RMSEA = 0.079 [.064, .094] SRMR = 0.026
EA	$\chi^2(2) = 45.01$, $p < .001$ CFI = 0.990; TLI = 0.969 RMSEA = 0.123 [.093, .155] SRMR = 0.013	$\chi^2(2) = 33.42$, $p < .001$ CFI = 0.983; TLI = 0.950 RMSEA = 0.153 [.110, .200] SRMR = 0.017	$\chi^2(2) = 85.82$, $p < .001$ CFI = 0.930; TLI = 0.791 RMSEA = 0.233 [.189, .282] SRMR = 0.042
EG	$\chi^2(1) = 3.79$, $p = .051$ CFI = 0.999; TLI = 0.996 RMSEA = 0.038 [.000, .082] SRMR = 0.004	$\chi^2(1) = 2.32$, $p = .128$ CFI = 0.999; TLI = 0.995 RMSEA = 0.040 [.000, .113] SRMR = 0.005	$\chi^2(1) = 0.59$, $p = .443$ CFI = 1.000; TLI = 1.000 RMSEA = 0.000 [.000, .077] SRMR = 0.002

Note. CCA and EG models include one residual covariance (CCA1↔CCA3 and EG3↔EG4 respectively), based on shared item content; the EA model is specified without residual covariances.

The scale for eco-guilt (EG) consists of 4 item (e.g. I feel guilty for not paying enough attention to the issue of climate change.) and was adapted from Ágoston et al. (2022a). Its reliability ranges from $\alpha = 0.87$ (Czech sample) to $\alpha = 0.88$ (Hungarian sample); pooled $\alpha = 0.87$ across the three samples combined. The EG scale demonstrated excellent fit across all three countries (CFI ≥ 0.99, RMSEA ≤ 0.04, SRMR ≤ 0.005; see Table 2).

To examine cross-national comparability, multigroup CFA was conducted to test configural, metric, and scalar measurement invariance across Hungary, Czechia, and Slovakia using MLR estimation, with the confirmatory half of the Hungarian sample combined with the Czech and Slovak samples. Because chi-square difference tests are highly sensitive to large samples, changes in incremental fit indices were used as the primary decision criterion. For the CCA scale, invariance testing indicated acceptable deterioration in fit from configural to metric (ΔCFI = 0.003, ΔRMSEA = −0.003) and from metric to scalar (ΔCFI = 0.008, ΔRMSEA = 0.002), supporting full scalar invariance across countries. For the EA scale, full scalar invariance was not supported (ΔCFI = 0.015); freeing the intercept of one item (EA4) resulted in partial scalar invariance (ΔCFI = 0.009, ΔRMSEA = 0.005). For the EG scale, metric invariance was supported (ΔCFI = 0.001), while full scalar invariance was not supported (ΔCFI = 0.012, ΔRMSEA = 0.037); freeing one intercept (EG2) resulted in partial scalar invariance (ΔCFI = 0.002, ΔRMSEA = 0.003). Overall, these results indicate that the constructs show comparable factor structures and loadings across countries, and that latent mean comparisons are defensible for CCA and can be conducted for EA and EG under partial scalar invariance, with the freed intercepts.

The scale for environemntal hope was adapted from Kerret et al. (2020) and consisted of 10 items. Its reliability ranges from $\alpha = 0.79$ (Czech sample) to $\alpha = 0.81$ (Slovakian sample); pooled $\alpha = 0.80$ across the three samples combined. As the scale has not been previously examined with factor analysis, an exploratory factor analysis (EFA) of the EH items was performed on the exploratory half of the Hungarian sample ($n = 1{,}917$) to identify the underlying structure. The Kaiser–Meyer–Olkin measure was high (overall KMO ≈ 0.87) and Bartlett's test was significant, supporting factorability. Principal Axis Factoring (PAF) with direct oblimin rotation was used, extracting factors with eigenvalues greater than 1. Cut-off values for loadings were set at 0.4, consistent with commonly acknowledged literature for large samples. This resulted in three

Table 3. The EFA for environmental hope (Hungarian exploratory half, $n = 1{,}917$).

	1st factor	2nd factor	3rd factor
1st item – I think I am doing pretty well in protecting the environment	**0.74***		
2nd item – I can think of many ways to protect the environment.	**0.71***		
3rd item – I protect the environment just as well as others in my age.			
4th item – When there is an environmental problem, I can come up with lots of ways to solve it.	**0.80***		
5th item – I think that things I have done in the past will help me protect the environment in the future.	**0.75***		
6th item – I trust the researchers and scientists to find solutions to improve environmental problems.			**0.56**
7th item – I think there are some politicians who seriously deal with environmental problems.		**0.68**	
8th item – I think that civil activists help finding solutions to environmental problems.		**0.54**	
9th item – I think technical progress will solve all environmental problems.		**0.61**	
10th item – Even when others give up on an environmental problem, I know I can find a solution.	**0.56***		

*items used as environmental self-efficacy (ESE sub-construct) for subsequent analyses.

factors had eigenvalues >1, but only the first factor was thematically coherent and had all loadings ≥0.4 across samples (see Table 3).

Based on the EFA findings, we treated the five items loading on the first factor as a measure of environmental self-efficacy (ESE), defined as students' belief in their own capacity to enact environmental protection. This factor included five items (e.g. 'I think I am doing pretty well in protecting the environment', 'I can think of many ways to protect the environment', etc.). The full 10-item scale yielded $\alpha = 0.81$, and the five-item ESE factor had $\alpha = 0.82$ in Hungary (Czech $\alpha = 0.83$, Slovak $\alpha = 0.80$; pooled $\alpha = 0.82$), indicating good internal consistency. Importantly, this shift is theoretically justified: prior work (e.g. Kerret et al. 2020; Li and Monroe 2018) has similarly observed that climate-related 'hope' scales often blend self-efficacy and optimism, and we align our construct with the self-efficacy interpretation.

To validate this structure independently, confirmatory factor analysis (CFA) was conducted on confirmatory half of the Hungarian sample together with the Czech and Slovak samples. This one-factor ESE model fit adequately in all three samples (HU confirmatory half: $\chi^2(5) = 53.70$, CFI = 0.973, RMSEA = 0.093 [0.071, 0.116], SRMR = 0.026; Czechia: $\chi^2(5) = 42.49$, CFI = 0.977, RMSEA = 0.086 [0.064, 0.111], SRMR = 0.023; Slovakia: $\chi^2(5) = 35.77$, CFI = 0.977, RMSEA = 0.081 [0.057, 0.107], SRMR = 0.026). Multigroup CFA across the three samples supported configural and metric invariance (ΔCFI = 0.004, ΔRMSEA = −0.012); however, both full and partial scalar invariance were not supported. ESE is therefore only retained in the structural path model, where metric invariance is sufficient.

Finally, for assessing the pro-environmental behavior of students, the 14-item scale based on previous studies (Ágoston et al. 2022a, 2024; Mónus, 2020, 2022) was used (e.g. At home, I always sort the garbage selectively.). The scale has not been examined with factor analysis yet, since it was developed for this research. Therefore, the EFA was performed on the exploratory half of the Hungarian sample ($n = 1{,}917$), with the resulting structure subsequently validated on the confirmatory half together with the Czech and Slovak samples. The Kaiser–Meyer–Olkin measure indicated excellent sampling adequacy (KMO = 0.89), and Bartlett's test of sphericity was significant ($\chi^2(91) = 10281.99$, $p < 0.001$),

Table 4. The EFA for pro-environmental behavior (Hungarian exploratory half, $n = 1{,}917$).

	1st factor	2nd factor	3rd factor
1st item - At home, I always sort the garbage selectively.		**0.67****	
2nd item - When leaving a room the last, I always switch off the lights		**0.57****	
3rd item - If I see people acting badly to nature, I immediately tell them.			
4th item - In my free time I watch nature shows on the Internet or on television.	**0.79***		
5th item - I frequently speak with my parents about how it is possible to help with solving environmental problems.	**0.75***		
6th item - I throw rubbish in the appropriate selective collectors in a public place.		**0.79****	
7th item - In my free time, I participate in events to help the environment.	**0.88***		
8th item - I often read about nature and the environment.	**0.81***		
9th item - When I am deciding what to take out of the refrigerator, I leave the doors closed.			
10th item - I do not buy or consume soft drinks and energy drinks in disposable packaging.	**0.49***		
11th item - I frequently speak with my friends about how it is possible to help with solving environmental problems.	**0.85***		
12th item - Whenever possible I walk, cycle or use public transport instead of using a car.			**0.83**
13th item - I usually sew, remodel, or give away my clothes instead of throwing them in the trash.			
14th item (R) - If something gets old, I like to buy/ get a new one as soon as possible.			

*Items used as regular environmentally-related behavior (PBH sub-construct) for subsequent analyses.
**Items used as irregular, intentional environmentally-related actions (PBA sub-construct) for subsequent analyses.

confirming suitability for factor analysis. The Principal Axis Factoring (PAF) with direct oblimin rotation was used for the exploratory factor analysis. The factor analyses revealed three factors with eigenvalues greater than 1. The three-factor solution demonstrated satisfactory model fit ($\chi^2(52) = 520.76$, $p < 0.001$; TLI = 0.945; RMSEA = 0.051, 90% CI [0.047, 0.055]; RMSR = 0.02). Parallel analysis suggested four factors, explaining 56.5% of the variance, of which the first two were thematically coherent (see Table 4).

The first factor consisted of five items reflecting irregular, intentional, and conscious environmentally related actions. The second factor included three items representing regular, habitual pro-environmental behaviors. The third factor contained two items and showed weaker interpretability and lower communalities, while the reversed item (14th item) did not meaningfully load on any factor, and demonstrated very low item–total correlation. Subsequent analyses therefore focused on the two theoretically meaningful sub-constructs: Pro-environmental Behavior - Intentional Actions (PBA) and Pro-environmental Behavior - Habitual Actions (PBH). The reliability of the full 14-item scale was satisfactory across the three samples ($\alpha = 0.77$ to 0.82; pooled $\alpha = 0.80$). For the PBA subscale, reliability was high in all three samples ($\alpha = 0.84$ to 0.87; pooled $\alpha = 0.86$), whereas the PBH subscale demonstrated acceptable reliability ($\alpha = 0.66$; pooled $\alpha = 0.64$).

To validate the two-factor structure on independent data, CFA of the PBA and PBH was conducted on the confirmatory half of the Hungarian sample together with the Czech and Slovak samples. The two-factor model fit acceptably to well in all three samples (HU confirmatory half: $\chi^2(19) = 180.09$, CFI = 0.963, RMSEA = 0.074 [0.064, 0.084], SRMR = 0.038; Czechia: $\chi^2(19) = 130.05$, CFI = 0.964, RMSEA = 0.064 [0.053, 0.074], SRMR = 0.036; Slovakia: $\chi^2(19) = 159.92$, CFI = 0.952, RMSEA = 0.079 [0.068, 0.091], SRMR = 0.052). Standardized loadings were substantial for the PBA factor across

all three samples (0.60 to 0.79) and moderate for the PBH factor (0.47 to 0.79). Multigroup CFA across the three samples supported configural and metric invariance (ΔCFI = 0.003, ΔRMSEA = −0.004); full scalar invariance was not supported (ΔCFI = 0.013, ΔRMSEA = 0.004), but partial scalar invariance was achieved by freeing the intercept of one item (PEB6; ΔCFI = 0.009, ΔRMSEA = 0.002).

Data analysis

The quantitative data were analyzed in R. Confirmatory factor analyses, multigroup measurement invariance tests, and the structural path model were estimated using the lavaan package with maximum likelihood with robust standard errors (MLR) and full-information maximum likelihood (FIML) for missing data. Exploratory and reliability analyses were conducted with the psych package. Country comparisons were conducted using one-way ANOVA with Bonferroni correction for pairwise post-hoc comparisons to control for Type I error. Hypotheses were tested against a five percent significance level, $\alpha = 0.05$, and the effect sizes were calculated using Cohen's d for pairwise contrasts and partial eta squared for omnibus ANOVA. The hypothesized relationships were tested using an observed-variable path analysis based on composite scores. The indices for model fit recommended by Hu and Bentler (1999) were observed. The strength of the relationship between model elements is represented by standardized regression weights and interpreted as follows: < 0.1 small effect, 0.11-0.25 medium effect, > 0.25 large effect.

Results

Climate change attitudes, environmental anxiety, environmental guilt and environmental self-efficacy: differences between national samples

A one-way ANOVA on the Climate Change Attitudes scale showed that there was no significant relationship between students' countries and their attitudes regarding climate change ($F(2,4641.861) = 1.567$, $p = 0.209$, $\eta_p^2 = 0$). According to the value of partial eta squared, the effect size is non-existent. Bonferroni post hoc test showed that every difference between national samples was not significant (see Table 5). Given that full scalar invariance was established for CCA, these results indicate genuine cross-national similarity in climate change attitudes among students.

The results of the one-way ANOVA on the Eco-anxiety scale showed that there was a significant relationship between students' countries and their ecological anxiety ($F(2,4693.824) = 5.464$, $p = 0.004$, $\eta_p^2 = 0.002$). Similar results could be found for the Eco-guilt scale ($F(2,4689.032) = 8.860$, $p < 0.001$, $\eta_p^2 = 0.003$). According to the value of partial eta squared, the effect sizes in both cases are very small. The results of the

Table 5. Differences between national samples for CCA (Bonferroni post hoc test).

	Hungary	Czech Republic	Slovakia
Hungary (M = 4.17, SD = 0.80)	–	–	–
Czechia (M = 4.12; SD = 0.79)	p = 0.551	–	–
Slovakia (M = 4.16, SD = 0.76)	p = 1	p = 0.272	–

Magnitude of differences is small.

Table 6. Differences between national samples for EA (Bonferroni post hoc test).

	Hungary	Czech Republic	Slovakia
Hungary (M = 3.74, SD = 1.08)	–	–	–
Czechia (M = 3.62, SD = 1.13)	p = 0.003	–	–
Slovakia (M = 3.70, SD = 0.96)	p = 0.642	p = 0.329	–

Table 7. Differences between national samples for EG (Bonferroni post hoc test).

	Hungary	Czech Republic	Slovakia
Hungary (M = 2.71, SD = 1.12)	–	–	–
Czechia (M = 2.65, SD = 1.08)	p = 0.120	–	–
Slovakia (M = 2.83, SD = 1.08)	p = 0.014	p < 0.001	–

Table 8. Gender differences for Hungarian sample (N_{girl} = 1652, N_{boy} = 1588).

	M_{girl}	SD	M_{boy}	SD	t	p	d
PBA	2.35	0.88	2.29	0.94	1.74	0.954	0.002
PBH	3.92	0.88	3.79	0.98	3.81	<0.001	0.15
CCA	4.26	0.76	4.05	0.87	7.20	<0.001	0.25
ESE	2.97	0.82	2.92	0.92	1.86	0.195	0.04
EA	3.95	0.98	3.49	1.15	12.40	<0.001	0.42
EG	2.92	1.08	2.47	1.12	11.64	<0.001	0.36

Table 9. Gender differences for Czech sample (N_{girl} = 804, N_{boy} = 743).

	M_{girl}	SD	M_{boy}	SD	t	p	d
PBA	2.17	0.80	2.05	0.82	3.07	0.022	0.11
PBH	4.25	0.71	4.02	0.86	5.74	<0.001	0.31
CCA	4.31	0.65	3.97	0.85	8.61	<0.001	0.47
ESE	2.73	0.83	2.68	0.90	1.24	0.154	0.07
EA	4.00	0.94	3.27	1.18	13.41	<0.001	0.70
EG	2.93	1.02	2.36	1.07	10.62	<0.001	0.52

Bonferroni post hoc test showed that the only significant difference for the eco-anxiety scale was between the Hungarian and Czech samples, with the students of the latter sample showing less anxiety, and for the eco-guilt scale, the Slovakian sample exercised more guilt than the Hungarian or Czech students (see Tables 6 and 7). As partial scalar invariance was achieved for EA and EG, these mean differences can be interpreted as reflecting genuine cross-national variation, although the

Climate change attitudes, eco-anxiety, eco-guilt and hope: gender differences

In the Hungarian sample, gender differences were significant for most of the investigated variables. In every case, girls reported a higher level of climate change related emotions or attitudes. Based on Cohen-d, the effect size could be interpreted as mild for pro-environmental behavior, and medium for climate change related attitudes, and most of the investigating emotions (see Table 8).

However, the Czech and Slovak samples slightly deviated from the Hungarian, as gender differences remained unsignificant for ESE (Czechia, Slovakia), and PBA (Slovakia) (see Tables 9 and 10):

While the effect size for most of the significant differences could be interpreted as small, for CCA, EA, and EG was the effect size relatively strong, particularly for the EA in the Czech sample.

Table 10. Gender differences for Slovakian sample (N_{girl} = 724, N_{boy} = 521).

	M_{girl}	SD	M_{boy}	SD	t	p	d
PBA	2.35	0.90	2.38	0.93	−0.50	0.056	−0.11
PBH	4.09	0.79	3.91	0.82	3.75	<0.001	0.23
CCA	4.39	0.70	4.09	0.79	7.04	<0.001	0.41
ESE	2.88	0.80	2.92	0.90	−0.73	0.310	−0.06
EA	3.93	0.93	3.49	1.04	7.82	<0.001	0.45
EG	3.04	1.03	2.63	1.14	6.61	<0.001	0.36

The relationship between environmental hope, climate change attitudes, eco-anxiety, eco-guilt, eco-hope, and the participants' pro-environmental behavior

To test the interrelationships between eco-anxiety, eco-guilt, environmental self-efficacy, climate change attitudes, and pro-environmental behavior, an observed-variable path model was estimated with the use of composite scores. Composite variables were calculated as the mean of the particular items to each construct and considered as observed indicators in the structural model. Robust maximum likelihood was used to estimate the model with full-information maximum likelihood. Climate change attitudes were regressed on eco-anxiety, habitual pro-environmental behavior was regressed on climate change attitudes and environmental self-efficacy, and intentional pro-environmental actions were regressed on environmental self-efficacy and eco-guilt. The covariances between the exogenous predictors (eco-anxiety, eco-guilt, and environmental self-efficacy) were estimated freely.

The hypothesized model and its paths were first tested on the total sample, and the model which fitted the data adequately and supported the hypothesized prediction paths was subsequently tested for all three national samples. The model showed good fit according to incremental and residual-based indices (CFI: 0.986, TLI: 0.970, SRMR: 0.025). The RMSEA suggested acceptable approximation error (RMSEA: 0.061 [0.053, 0.069]). All the given structural paths were significant ($p < 0.001$). Eco-anxiety was highly and significantly positively associated with climate change attitudes. Climate change attitude, in turn, was positively related to habitual pro-environmental behavior, whereas the environmental self-efficacy was positively linked to habitual behavior. Intentional pro-environmental actions had the strongest association with Environmental self-efficacy, eco-guilt also had a additional positive association with intentional actions.

The same model was then estimated separately for Hungary, Czechia, and Slovakia. The resulted models and their model fits are presented below (Figures 1–3), they were obtained with the following fit indices: CFI: 0.979; TLI: 0.955; RMSEA: 0.077 [0.066, 0.088]; SRMR: 0.031 (Hungary), CFI: 0.996, TLI: 0.992, RMSA: 0.030 [0.010, 0.050], SRMR: 0014 (Czechia), CFI: 0.967, TLI: 0.929, RMSEA: 0.089 [0.071, 0.108], SRMR: 0.031 (Slovakia). The Czech model showed excellent fit, while the Hungarian and Slovak models showed acceptable to borderline fit, with the Slovak RMSEA at the upper bound of conventional cut-offs. The results of the three national samples reveal that there is a central role of environmental self-efficacy in explaining pro-environmental behavior. Higher environmental

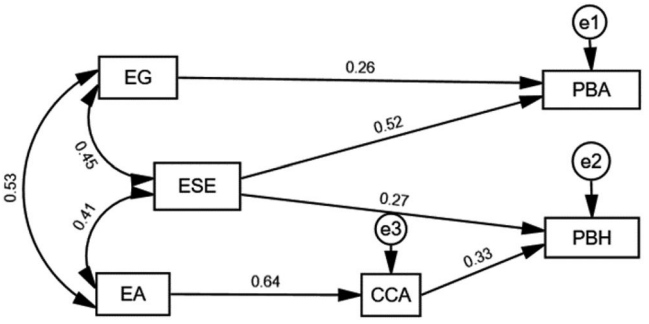

Figure 1. Climate emotions – attitudes – behavior model (Hungary). Fit: CFI = 0.979; TLI = 0.955; RMSEA = 0.077 [0.066,0.088]; SRMR = 0.031.
Note: EG = eco-guilt, ESE = environmental self-efficacy, EA = eco-anxiety, CCA = climate change attitudes, PBA = intentional deliberate pro-environmental action, PBH = habitual pro-environmental behavior.

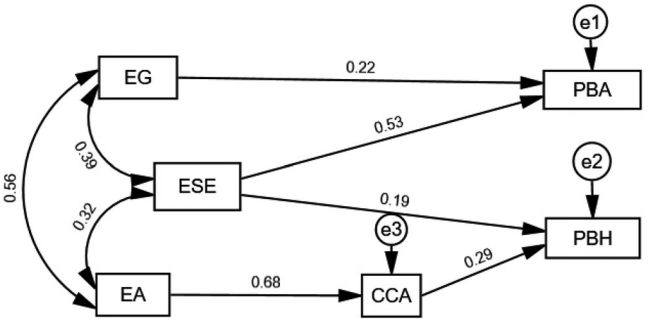

Figure 2. Climate emotions – attitudes – behavior model (Czechia). Fit: CFI = 0.996; TLI = 0.992; RMSEA = 0.030 [0.010,0.050]; SRMR = 0.014.
Note: EG = eco-guilt, ESE = environmental self-efficacy, EA = eco-anxiety, CCA = climate change attitudes, PBA = intentional deliberate pro-environmental action, PBH = habitual pro-environmental behavior.

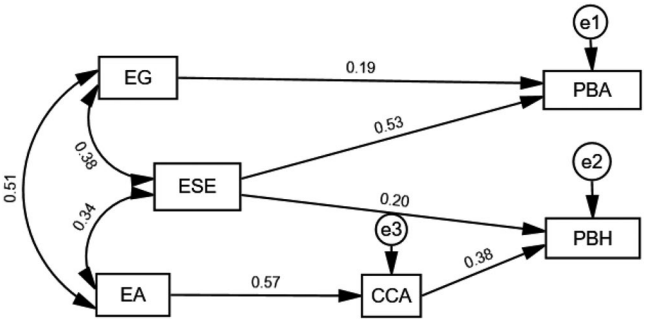

Figure 3. Climate emotions – attitudes – behavior model (Slovakia). Fit: CFI = 0.967; TLI = 0.929; RMSEA = 0.089 [0.071,0.108]; SRMR = 0.031.
Notes: EG = eco-guilt, ESE = environmental self-efficacy, EA = eco-anxiety, CCA = climate change attitudes, PBA = intentional deliberate pro-environmental action, PBH = habitual pro-environmental behavior.

self-efficacy was consistently linked with intentional pro-environmental behavior, and to a lesser extent, with habitual pro-environmental behavior. Environmental self-efficacy in all countries was found to have the most significant direct

predictive relationship with intentional action, and moderate relationship with the habitual behavior. Environmental self-efficacy associated with eco-anxiety in a positive way as well as eco-guilt, which means that students who reported that they were more convinced in the efficacy of their personal environmental action also were more likely to say that they experienced stronger climate-related feelings. Eco-anxiety was associated with climate change attitudes in all samples strongly. In turn, climate change attitudes were positively associated with habitual pro-environmental behavior, which indicates that the role of eco-anxiety is to predict routine environmental action mainly *via* attitudinal mechanisms. Eco-guilt demonstrated a direct relationship with intentional and less frequent pro-environmental actions.

Discussion

The following discussion is organized around the three central questions of this study: cross-national and gender differences in students' climate-related emotions, attitudes, and behavior; the structural relationships among these constructs; and the role of environmental self-efficacy in shaping pro-environmental behavior.

The role of gender and country on students' attitudes, environmental hope, eco-anxiety, eco-guilt, and pro-environmental behavior

Regardless of culture diversity, the differences among the involved countries seem to be relatively small and practically insignificant. Nevertheless, Czech students appear to be less concerned about climate change than their peers from Slovakia and Hungary. This finding aligns with the comparative public opinion survey presented by Leiserowitz et al. (2022). It could be argued that students' perceptions of climate threats are influenced by factors such as media, national curricula, or other variables not captured in this study. However, this explanation lacks support from relevant studies and should therefore be considered speculative at best.

Similarly, while the models presenting the relationships between climate-related emotions, environmental self-efficacy and pro-environmental behavior differ in details, they exhibit the same patterns in all the countries. It might indicate that the contemporary adolescents from different countries perceive the threats of climate change similarly, regardless of their cultural context. However, such a claim would need to be tested by expanding the scope of involved countries.

The gender differences identified in this study align with findings from other research (Hermans and Korhonen 2017; Hornsey et al. 2016; Lehnert et al. 2019; Oliver and Adkins 2020; Pfautsch and Gray 2017). However, Rothermich et al. (2021) found stronger climate change attitudes among males. Bush and Clayton (2023) argue that while men tend to be less concerned about climate change, the differences are influenced by a country's wealth: in wealthier countries, the gender gap is more pronounced. Given the relatively similar economic conditions of the countries involved, this theory could not be tested in the current study.

The relationship between environmental hope, climate change attitudes, eco-anxiety, eco-guilt, and the participants' pro-environmental behavior

The findings confirm the positive role of eco-guilt on Hungarian, Czech and Slovakian students' environmental behavior. It corresponds with Ágoston et al. (2022b) and other authors (Ojala 2012; Sanson, van Hoorn, and Burke 2019; Soutar and Wand 2022). However, the direct impact of guilt on environmental behavior seems relatively mild, while its more prominent impact is indirect.

Contrary to the other studies (Ágoston et al. 2022b; Clayton 2020; Dunlop and Rushton 2022; Hiser and Lynch 2021; Sanson, van Hoorn, and Burke 2019), but in line with Clayton and Karazsia (2020), we did not find a direct impact of eco-anxiety on environmental behavior in any of the national samples. Both eco-anxiety and eco-guilt seem to have indirect effects moderated by environmental self-efficacy (and climate change attitudes in case of eco-anxiety). It supports the claims of the complexity of students' feelings regarding environmental issues and climate change (Pihkala 2020; 2022).

However, the findings may also support the need for effective coping with students' negative feelings (Ágoston et al. 2022b; Clayton 2020; Clayton and Karazsia 2020; Dunlop and Rushton 2022; Hiser and Lynch 2021; Sanson, van Hoorn, and Burke 2019). They show that eco-anxiety and eco-guilt are not necessarily opposed to self-efficacy. On the contrary, all three emotional states seem relatively strongly and positively related. It suggests that students' environmental self-efficacy (and their hopefulness in general) may be built by meaning- or problem-focused coping strategies, as suggested by Ojala (2012) and Ojala and Bengtsson (2019). Both strategies are supposed to accept the severity of the environmental crisis but develop constructive hope by focusing on action or finding meaning in the situation. As a result, students may be concerned, but they remain hopeful regarding environmental issues. Based on this, including strategies for positive coping with students' eco-anxiety and eco-guilt (e.g. providing mental support, discussing the issue in a supportive environment, practicing self-reflecting) seems to be an essential part of education (Diffey et al. 2022; Dunlop and Rushton 2022; Klocker et al. 2023; Ojala 2012; Pihkala 2020; Verlie 2019; Verlie et al. 2021).

Furthermore, the study highlights the ambiguous role of climate change attitudes. For all three national samples, these attitudes appear to be strongly influenced by students' eco-anxiety and are related to pro-environmental behavior habits (e.g. recycling, switching off lights), but not to pro-environmental social action. This finding may suggest that while students with a high level of anxiety support the importance of social action toward climate protection, this attitude itself does not implicate their willingness to take action, exceeding the relatively effortless low-cost habits. This finding corresponds with Lehnert et al. (2019), who found that students support climate protection policy but question their capacity to promote change. Based on this, promoting climate change attitudes (e.g. by highlighting the issue's urgency or anthropogenic influence on climate change) may not be a sufficient teaching strategy for motivating students to protect the climate.

The prominent role of self-efficacy for students' pro-environmental behavior

Participants' environmental self-efficacy is the strongest predictor of students' environmental behavior of all analyzed variables (in all the samples). Such a finding has significant educational implications. Promoting students' self-efficacy (and their hopefulness in general) for the future is the most promising strategy in climate change education. Strategies like sharing stories of successful environmental protection or providing opportunities for collective actions (Baker, Clayton, and Bragg 2021; Chawla 2020; Marks et al. 2022; Soutar and Wand 2022) can effectively promote students' sense of hope for the future.

Our results also confirm a very close relation of the hope and self-efficacy concepts and their overlaps. As Snyder shows (2002), the self-efficacy concept (Bandura 1977, 1997) and the hope theory (Snyder, Rand, and Sigmon 2002) share fundamental operative processes of goal and outcome orientation, agency-related and pathway-related thinking. But Snyder and other authors also point out differences: goals in hope theory are rather enduring, cross-situational, whether self-efficacy theory supposes contingencies in a given situation (Snyder, Rand, and Sigmon 2002), or, as Rand and Rogers (2023) state, 'hope involves 'I will' beliefs; whereas, self-efficacy involves 'I can' beliefs' (p. 3). However, some authors, when developing scales for measuring hope, utilize both 'hope' and 'self-efficacy' items. For example, Li and Monroe, who developed Climate Change Hope Scale, declared that their definition of hope combined goals, willpower, self-efficacy and optimism into one psychological concept, and their scale included self-efficacy items of the 'I can' category. Or Kerret et al. (2020), whose Environmental Hope Scale was used in this study, compiled self-efficacy items for agency thinking and pathway thinking, and items for social trust into one scale. But as the results of the exploratory factor analysis described above showed, within this study self-efficacy emerged as a very clearly defined sub-construct (including mostly 'I can' items) and its major predictive role in the structural equation modelling proved to be independent.

In case of the participants of this study in all three countries, what matters is not their belief in someone else's actions, but their belief in their own capacity to promote change. These findings can be interpreted in the context of coping strategies defined by Ojala (2012): placing trust in influential social actors may serve as a valid coping strategy, but it does not necessarily motivate pro-environmental action. The findings suggest two complementary avenues for climate change education exist. The first is focused on promoting students' self-efficacy and hope by involving students in real-world projects, sharing positive examples of successful action, and actively developing their belief that a change is possible. The second is focused on facilitating students' negative feelings through coping mechanisms, ultimately leading to action and hope. Teachers should be able to apply both approaches in their practice: to facilitate the coping processes and to actively build students' hope. While they should not focus on highlighting the severity of the issues, they should also not ignore the students' worries and shame. At the same time, dealing with students' emotions may not be enough; actively developing students' hope seems crucial.

The complementarity of both the avenues calls for teachers competent in a broad scale of teaching strategies. It could be argued that both pre-service and in-service teacher training should focus on enhancing teachers' capacity to identify, acknowledge and work with students' climate-related emotions, and to develop students' self-efficacy in coping with them. Last but not least, these areas should also be analogously promoted in teachers themselves: only teachers who believe in their capacity to help the environment and effectively manage their own climate-related emotions can model these qualities to their students. This may call for a dramatic reconsideration of teacher training, not only in the countries involved in this study.

Limitations

The validity of the study may have been negatively affected by the lower consistency of some of its scales. Specifically, the original scales for pro-environmental behavior and environmental hope required reconsideration and subsequent reconceptualization. While the adopted solution provided deeper insights into the analyzed area, it also creates an opportunity for future researchers to develop more refined scales that capture the multidimensional nature of environmental hope and pro-environmental behavior.

A more elaborated operationalization of the climate-related emotions could bring additional insights. For example, it may be argued that the emotions of „eco-guilt 'and' eco-self-blame 'could have been more differentiated in the study', with a potential to compare their impact on climate behavior and action.

Although the intercultural context of the study offers certain benefits, the selection of the countries involved was based on convenience rather than a deeper rationale. A more purposeful selection could allow for a more nuanced comparison, potentially uncovering additional patterns in students' climate-related emotions.

All data were collected in 2022. Changes in the policy landscape worldwide, and specifically in the involved countries, might have affected public attitudes and beliefs about climate change and, consequently, have complicated the generalisability of the results to the contemporary situation.

Conclusion

The study showed that the differences in the intensity of climate-related emotions among students from three Central European countries are unimportant. Regardless of the different cultural contexts, students seem to perceive and react to climate change threats similarly: the feelings of anxiety motivate them to keep environmentally-related habits, while their self-efficacy (and guilt, to a lesser degree) to take action.

Based on this, the implications for the pedagogical practice in Czechia, Slovakia, and Hungary do not differ. For each country, the study supports two simultaneous approaches to climate change education: one focused on fostering students' environmental self-efficacy and another aimed at promoting students' climate-related coping strategies.

Furthermore, the study underscores the importance of acknowledging emotions as an integral part of climate change education. It calls for incorporating relevant

strategies into in-service and pre-service teacher training to equip teachers with the skills to guide students through the complex emotional dimensions of climate change.

Finally, the study opens an opportunity for further research. Would repeating the study in other countries reveal the same interrelationship structure among students' climate change-related emotions and behavior? Would the role of eco-anxiety and guilt in motivating students to protect the environment differ when different coping strategies are applied? How do students interpret the way they transfer their emotions to action?

Climate change emotions and their importance for students' behavior are crucial areas of contemporary climate change education research. This study provided some insights, but further work is necessary to understand this topic.

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Ethical approval

The research was performed according to the APA Ethical Principles and considered the national laws in each country. The concept of the research and the English and Hungarian versions of the research tools were approved by the Research Ethics Committee of ELTE Eötvös Lorand University, Faculty of Pedagogy and Psychology approval. The number of the ethical approval is 2022/379.

Author contributions

CRediT: **Jan Činčera**: Conceptualization, Supervision, Writing – original draft, Writing – review & editing; **Miloslav Kolenatý**: Formal analysis, Writing – original draft, Writing – review & editing; **Roman Kroufek**: Formal analysis; **Syed Ahsan Ali Shah**: Formal analysis; **Bohuslav Binka**: Writing – original draft; **Gergely Rosta**: Funding acquisition, Investigation, Methodology, Project administration; **Dániel Sziva**: Investigation; **Alexandra Hengerics Szabó**: Investigation; **Katarína Szarka**: Investigation; **Ferenc Mónus**: Investigation, Methodology; **Attila Varga**: Data curation, Investigation, Methodology.

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Appendix. Scale items

Students' climate change attitudes in the Czech Republic, Slovakia, and Hungary

(the scale items were translated into Hungarian, Slovak and Czech, the factor consistency and scale reliability of the translated scales were verified by EFA or CFA analyses and the Cronbach's alpha test)

Climate Change Attitudes (CCA) scale, adapted from Christensen and Knezek (2015**)**
To what extent do you agree with following statements?
Indicate your answer using a scale ranging from 1 ("totally disagree") to 5 ("totally agree").

1. The climate of our planet is changing.
2. I am concerned of climate changes.
3. The climate changes have been already proved.
4. Global climate change will change our environment in the next ten years.
5. Global climate change will influence the next generations.
6. Everyone can contribute to solving of climate changes.
7. Ongoing climate changes are of the most part caused by human activities.
8. Climate changes have negative effects on our lives.

Eco-anxiety (EA) and Eco-guilt (EG) scales, adapted from Ágoston et al. (2022a**)**
People have many different thoughts, feelings, and reactions regarding climate change. Please indicate how strongly you agree or disagree with the following statements.
Indicate your answer using a scale ranging from 1 ("totally disagree") to 5 ("totally agree").

1. I am terrified by how many things have changed in just a few years because of climate change.

2. I am worried about the increasing number of natural disasters caused by climate change.
3. It scares that the weather is becoming more and more unpredictable because of climate change.
4. I find it terrifying that the seasons have changed a lot in a short time.
1. I feel guilty for not paying enough attention to the issue of climate change.
2. The more I know about the human causes of climate change, the more things I feel guilty about.
3. I am constantly angry with myself because I think that I am not doing enough and that I am harming the environment by my very existence.
4. It makes me feel uneasy that I am part of a system that is amplifying climate change.

Environmental Hope scale, adapted from Kerret et al. (2020**)**

To what extent do the following statements describe you?

Indicate your answer using a scale ranging from 1 ("does not describe me at all") to 5 ("totally describes me").

1. I think I am doing pretty well in protecting the environment
2. I can think of many ways to protect the environment
3. I protect the environment just as well as others in my age
4. When there is an environmental problem, I can come up with lots of ways to solve it
5. I think that things I have done in the past will help me protect the environment in the future
6. I trust the researchers and scientists to find solutions to improve environmental problems
7. I think there are some politicians who seriously deal with environmental problems
8. I think that civil activists help finding solutions to environmental problems
9. I think technical progress will solve all environmental problems.
10. Even when others give up on an environmental problem, I know I can find a solution.

Pro-environmental Behavior scale, based on previous studies (Mónus 2020, 2022**;** Ágoston et al. 2022a, 2024**)**

To what extent do the following statements describe you?

Indicate your answer using a scale ranging from 1 ("does not describe me at all") to 5 ("totally describes me").

1. At home, I always sort the garbage selectively.
2. When leaving a room the last, I always switch off the lights.
3. If I see people acting badly to nature, I immediately tell them.
4. In my free time I watch nature shows on the Internet or on television.
5. I frequently speak with my parents about how it is possible to help with solving environmental problems.
6. I throw rubbish in the appropriate selective collectors in a public place.
7. In my free time, I participate in events to help the environment.
8. I often read about nature and the environment.
9. When I am deciding what to take out of the refrigerator, I leave the doors closed.
10. I do not buy or consume soft drinks and energy drinks in disposable packaging.
11. I frequently speak with my friends about how it is possible to help with solving environmental problems
12. Whenever possible I walk, cycle or use public transport instead of using a car.
13. I usually sew, remodel, or give away my clothes instead of throwing them in the trash.
14. If something gets old, I like to buy/ get a new one as soon as possible.