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CLIMATE CHANGE ATTITUDES, RELATIONSHIP TO NATURE AND PRO-ENVIRONMENTAL BEHAVIOUR OF STUDENTS FROM THREE EUROPEAN COUNTRIES

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Abstract. *Climate change is not a future problem, it is a significant variation of weather conditions becoming warmer, wetter or drier. It is the longer-term trend that differentiates climate change from natural weather variability. The aim of this research was to determine primary school students' knowledge and attitudes related to climate change among primary school students (n = 473) in the Czech Republic, the United Kingdom and Portugal using a questionnaire survey. The dimensions of climate change knowledge, environmental attitudes and values, pro-environmental behaviour, and climate change attitudes were measured and analysed. The results showed gender differences in favour of girls in all the dimensions studied, except for climate change knowledge, where the results of boys and girls were comparable. In an international comparison, UK children scored higher on climate change knowledge and climate change attitudes dimensions. A multiple regression analysis showed the dimensions of nature preservation and appreciation of nature as the strongest positive predictors of pro-environmental behaviour and the dimensions of climate change knowledge and nature preservation as the strongest predictors of climate change belief. The results suggest the importance and implications of the wider societal debate on climate-related personal dimensions. The interconnectedness of environmental and climate-related topics at the primary school level is also evident.*

Keywords: *climate change attitudes, climate change education, climate change knowledge, environmental attitudes, pro-environmental behaviour, primary school*

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Introduction

Climate Change Education

Ongoing climate change and the ensuing consequences in the form of local, regional, and global environmental, social, and economic crises currently represent a major challenge facing human civilisation. It is therefore not surprising that efforts to mitigate climate change are currently reflected in a wide range of fields of human activity. There has been a substantial development of research related to climate change in recent years in education. A review study of articles dedicated to research on climate change education in primary schools (Nepras et al., 2022) shows the gradual development of the topic after 2009 and a steep increase in the number of published research papers since 2019.

Knowledge, attitudes, willingness to act, and behaviour to mitigate climate change are the main areas that have been investigated in climate change education research in recent years. The development of climate change knowledge is a prerequisite for the development of other dimensions related to young people's relationship to climate change. The level of knowledge about climate change is related to the age and corresponding mental potential of young people. For primary school students, knowledge is incomplete and contains incorrect elements, yet is embedded in structurally correct mental models. The task of education at this level should therefore be to transform existing mental models (Chang & Pascua, 2015). Older children have some basic knowledge about climate change and energy, but the environmental impacts of energy use remain unclear (Pearce et al., 2020). It is only with the transition to upper-secondary school that the positive impact of schooling gradually becomes more apparent in a greater understanding of the complex issues of the causes and consequences of climate change and the basic principles of the greenhouse effect (Jurek et al., 2022). In doing so, Shepardson et al. (2009) suggested that an understanding of the concept of the greenhouse effect is necessary to achieve an effective understanding of global warming and its connection to climate change. Reducing misconcep-

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tions about the stepping stones of climate change knowledge in primary school can thus make the entire teaching process more effective.

Regarding attitudes towards climate change, it is known from studies conducted in primary schools that students perceive the impacts of climate change as a problem (Hermans & Korhonen, 2017) and experience negative emotions when talking about the consequences of climate change (Pearce et al., 2020). At the same time, it is often not perceived as a priority issue, climate change risks are usually second only to short-term risks (Nkoana, 2019). In addition, there is evidence that there are significant differences in attitudes toward climate in terms of different groups of students. The effect of gender, age and grade was significant on attitudes toward climate change (Dijkstra & Goedhart, 2012). In addition, girls have higher levels of the perceived risk of climate change and a greater willingness to act (Hermans & Korhonen, 2017; Stevenson et al., 2014; Stevenson et al., 2016). It is therefore not possible to influence children's climate attitudes without respecting these facts.

Climate change awareness is linked to climate knowledge. As noted, knowledge about climate change is a prerequisite for the acceptance of anthropogenic global warming (Stevenson et al., 2014). Teachers themselves have, of course, a significant influence on building acceptance of anthropogenic global warming, as teachers' beliefs about climate change, along with students' knowledge about climate change, are among the strongest predictors of students' beliefs that climate change is occurring and that anthropogenic global warming is taking place (Stevenson et al., 2016).

Documented predictors of climate change mitigation behaviour, according to current studies, are knowledge about climate change (Busch et al., 2019; Lavonen, 2022; Mohamed Ali Khan et al., 2020; Ratinen & Uusiautti, 2020), social norms (Busch et al., 2019; Stevenson & Peterson, 2015; Valdez et al., 2017), beliefs (Karpudewan, 2019; Mohamed Ali Khan et al., 2020), climate change concerns (Stevenson & Peterson, 2015; Valdez et al., 2017), hopes (Ratinen & Uusiautti, 2020; Stevenson & Peterson, 2015), personal norms and values (Karpudewan, 2019) and motivations (Mohamed Ali Khan et al., 2020). A greater willingness to act in favour of climate change mitigation measures is reported by women (Hermans & Korhonen, 2017; Lehnert et al., 2019; Ratinen & Uusiautti, 2020) and is conditioned by a higher interest in general environmental issues and the perceived importance of climate change mitigation measures (Hermans & Korhonen, 2017).

Climate change education is associated with a variety of different teaching approaches taken from more general environmental education. Earlier comparisons show the importance of interactive learning compared to short-term interventions (Reis & Ballinger, 2018). More specific strategies confirm the importance of the democratic approach described in the k.i.d.Z.21 (Competent into the Future) initiative tracking framework. It indicates that democratic learning in and out of school can enhance action-related components of climate change awareness (Deisenrieder et al., 2020). The same programme also draws on findings about the benefits of constructivist approaches to climate education (Keller et al., 2019). Akaygun and Adadan (2020) documented the role of inquiry-based instruction in terms of promoting students' scientific understanding of climate change. In tracking participatory projects such as Climate Change + Me (Cutter-Mackenzie & Rousell, 2018) and Science, Camera, Action! (Trott, 2019), benefits in terms of increased knowledge and motivation have been documented. In doing so, it has been shown that the effect of learning strategies can be amplified by combining effective methods (Keller et al., 2019).

Innovative approaches are successfully used in current climate change education. They contribute to the development of climate change knowledge, skills, motivation, awareness, and understanding. Some of the activities are related to the diverse use of new technologies, such as robotics (Ruiz Vicente et al., 2020), computer models (Jacobson et al., 2020), virtual learning (Petersen et al., 2020) and digital games (Harker-Schuch et al., 2020). Others work with the direct use of student participation in the learning process. In these, students act as co-researchers (Cutter-Mackenzie & Rousell, 2018), speak in intergenerational discussions (Hu & Chen, 2016), or participate in an after-school programme (Trott, 2019). Some approaches have introduced more systematic curricular adaptations or models, such as geospatial curriculum (Bodzin & Fu, 2013), cross-curricular experiential climate change curriculum (Siegner, 2018), or integrated social studies and language arts framework (Siegner & Stapert, 2019).

The Research Problem

As can be seen from the previous text, there is a great deal of research on climate education. Most of it focuses on validating specific educational approaches or describing a specific variable (attitudes, knowledge, behaviour...) with a geographically limited sample of respondents. International comparisons are rare.

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The lack of data describing the relationship between a more diverse set of observed variables while crossing the geographical boundaries of a single country is a problem that this study attempts to address.

Given the limitations of the study, described in the relevant chapter, this study primarily sought to pilot test the use of specific research tools across different countries and indicate how the variables of interest (environmental attitudes, climate knowledge and attitudes, pro-environmental behaviour) relate to each other.

The results may indicate not only what direction further international research should take, but also which of the variables studied are key to pro-environmental behaviour and climate attitudes. These variables should then be considered in the further education of students.

Research Focus

The topic of climate change ranks among marginal issues in all types of schools. It is a little bit of a controversy, due to the environmental policy of many countries and institutions. The aim of this research was to determine primary school students' knowledge and attitudes related to climate change and to measure the effect of gender and country on the relationship to nature, utilisation of nature, nature protection, willingness to act, climatic beliefs, climatic intentions, climatic knowledge and pro-environmental behaviour and also find out the correlation between dependent variables.

This research was designed to answer the following questions:

1. What are the students' knowledge and attitudes toward climate change?
2. What is the effect of gender and country gender and country on the relationship to nature, utilisation of nature, nature protection, willingness to act, climatic beliefs, climatic intentions, climatic knowledge, and pro-environmental behaviour?
3. What is the correlation between variables such as relationship to nature, utilisation of nature, nature protection, willingness to act, climatic beliefs, climatic intentions, climatic knowledge and pro-environmental behaviour?

Research Methodology

General Background

The research was designed as a quantitative study due to the higher number of dimensions studied. It was carried out in the form of a questionnaire survey and subsequent statistical analysis of the data obtained. Data collection took place in the United Kingdom, the Czech Republic and Portugal in the winter period of 2021/2022.

Participants

Research participants were students of the ISCED 2 level of education (International Standard Classification of Education, UNESCO, 2012) according to the aims specified above.

The selection of respondents for the study was heavily influenced by the constraints of the COVID-19 pandemic; therefore, respondents were included based on accidental sampling. A total of 479 respondents completed the questionnaire. The selection of respondents was convenient due to the reasons mentioned above. The problems with probability in social research are very often, as many authors claimed (O'Muircheartaigh & Hedges, 2013). The limits of this sampling should be eliminated by using appropriate statistical methods, ensuring reliability, the accuracy of the researchers' descriptions and measurements, the validity of data and also the calculation of effect size (Etikan & Bala, 2017; Seale et al., 2003). All mentioned procedures were adhered to. Out of this number, 6 questionnaires were discarded due to incomplete data or the extreme structure of answers that did not correspond to the standard way of completion (e.g. the answers to all the questions of the questionnaire were identical). Thus, a total of 473 respondents were included in the statistical analysis. 304 respondents were from the Czech Republic, 125 were from the United Kingdom and 44 were from Portugal. The average age of the respondents was 13.47 years, the sample was roughly gender-balanced overall, with a slight predominance of girls (50.5%). A detailed overview of the number of respondents and their basic characteristics is provided in Table 1.

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Table 1
Number and Main Characteristics of the Respondents Involved in the Survey

Country	Number of respondents	Mean age	*SD*	Ratio of girls
Czech Republic	304	13.16	1.28	.48
United Kingdom	125	14.16	1.45	.54
Portugal	44	13.64	1.09	.57
Σ	473	13.47	1.38	.51

Instrument and Procedures

A questionnaire including published instruments, modified items and original questions was developed for the research. The questionnaire was professionally translated into the national languages of the respondents (Czech, English, Portuguese) for distribution purposes. Before the implementation of the survey, pilot testing of the questionnaire was conducted in the Czech Republic. Sixty students were involved in the piloting. Based on a statistical analysis of the responses obtained, the reliability of the instruments and individual items used were evaluated. As a result of the pilot testing, some questionnaire items were removed, replaced, supplemented, or modified and the final version of the questionnaire was prepared.

The questionnaire is divided into two input sections and four main sections. The introduction section asks for gender, age, and year of education. The following sections are already standard sub-research instruments and focus on climate knowledge, environmental values and attitudes, pro-environmental behaviour, and climate change attitudes.

The items of the climate knowledge instrument are originally formulated. In part, they are paraphrased questions related to climate literacy based on the Test of Ecological and Environmental Knowledge, which is part of the Environmental Literacy Methodology (Činčera & Kroufek, 2021). The instrument includes eight items with possible answers: I agree – I disagree – I do not know. A correct answer was scored with one point, with a maximum of 8 points possible from the knowledge test.

The instrument that tracked the environmental values and attitudes of respondents is based on Bogner's original 2-MEV research tool (Bogner, 2018). It was adopted in the version according to the Environmental Literacy Methodology (Činčera & Kroufek, 2021). It includes three dimensions - Preservation, Utilization and Appreciation and a subscale of Commitment to Action. The instrument contains a total of 21 items on which respondents comment on a 5-point Likert scale: I agree - I rather agree - I am not sure - I rather disagree - I disagree.

Pro-environmental behaviour is measured using an instrument adopted from the Environmental Literacy Methodology (Činčera & Kroufek, 2021). The instrument contains a total of 10 items on which respondents comment on a 5-point Likert scale: I agree - I rather agree - I am not sure - I rather disagree - I disagree.

The climate change attitudes instrument is adapted from the Climate Change Attitude Survey (Christensen & Knezek, 2015) and includes two dimensions - Beliefs and Intentions. It contains a total of 15 items. The Intentions dimension items were partially modified from the original after pilot testing. Respondents comment on the items on a 5-point Likert scale: I agree - I rather agree - I am not sure - I rather disagree - I disagree. The reliability of each tool is presented in Table 2.

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Table 2
Reliability (Cronbach's Alpha) of the Instruments and Sub-dimensions Used.

Research tools/dimensions	Questionnaire items	Cronbach's alpha
Climate change knowledge	1.1-1.8	.63
Environmental values and attitudes		
Preservation	2.1-2.9	.83
Utilisation	2.10-2.16	.68
Appreciation	2.17-2.21	.85
Willingness to act	2.4-2.9	.83
Pro-environmental behaviour	3.1-3.10	.83
Climate change attitudes		
Beliefs	4.1-4.8, 4.10	.86
Intentions	4.9, 4.11-4.15	.71
In general	4.1-4.15	.88

The questionnaires were distributed exclusively in an online version built in Google Forms due to the persistent organisational barriers related to the spread of COVID-19. After prior arrangement with the management of the participating schools, the questionnaires were distributed via email links that were forwarded to teachers within the schools by the school contact persons. Questionnaires were distributed directly to students by their science teachers. The questionnaires were always completed anonymously. The forms did not record any information about the respondents other than the answers to the questionnaire items. The English version of the questionnaire is available as an appendix to this article.

The Ethics Committee of the Faculty of Education, Jan Evangelista Purkyne University in Usti nad Labem, evaluated and approved this project and did not find any conflicts with valid principles, regulations, and international guidelines for research involving human participants. The permission is under reference number 2/2021/01.

Data analysis

For statistical analysis, data files were prepared in MS Excel. Incomplete and non-standard records were removed from the file. The data distribution was normal for the pro-environmental behaviour scale ($W = 0.99$, $p = .06$). For all other scales, the data distribution was statistically significantly different from the normal distribution ($p < .001$) Descriptive quantitative statistics of the results of each item, dimensions and instruments were compiled from the data collected. Respondents' gender and the country where the research was conducted were successively selected as independent predictors. In the next stage, correlations (Spearman's ρ) between the findings of the sub-dimensions were established. Multiple linear regression was then applied with several dependent variables. A t-test was used to test the significance of the difference in the means of the two groups. Cohen's d was calculated to verify the effect size. The t-test was chosen because it is sufficiently robust even in the case of non-normal data distribution (Rasch & Guiard, 2004; Rasch et al., 2007).

Due to the unequal sample sizes across countries, Bartlett's test for equal variance was first implemented. The variances are not equal ($p < .001$), so the Kruskal-Wallis test was used to compare countries. For the effect size, the eta-squared measure (η^2) was computed (Tomczak & Tomczak, 2014) and then transferred to Cohen's *d* (Lenhard & Lenhard, 2016).

Research Results

Descriptive Comparisons

The results showed higher scores in favour of girls compared to boys in the dimensions tracking attitudes, beliefs, and behaviour. This was valid for the following dimensions: conservation, appreciation, pro-environmental

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behaviour, beliefs, intentions, and climate change attitudes. In the utilisation dimension, in contrast, the ratio is reversed. The results of climate change knowledge for girls and boys came out as comparable. Table 3 provides a detailed overview.

Table 3
Comparison of Results for Each Dimension Between Boys and Girls

Research tools/dimensions	Girls			Boys			*t*	Cohen's *d*
	M	*SD*	*Mdn*	*M*	*SD*	*Mdn*		
Climate change knowledge	5.51	1.81	6	5.53	1.94	6	-0.11	-0.01
Environmental values and attitudes								
Preservation	4.01	0.62	4.11	3.55	0.81	3.67	6.95**	0.64
Utilisation	2.19	0.66	2.14	2.57	0.72	2.57	5.94**	-0.55
Appreciation	4.00	0.87	4.20	3.13	1.09	3.10	9.59**	0.88
Willingness to Act	3.87	0.80	4.00	3.33	0.98	3.33	6.66**	0.61
Pro-environmental Behaviour	3.21	0.79	3.30	2.91	0.83	2.90	4.03**	0.37
Climate change attitudes								
Beliefs	4.24	0.65	4.33	4.04	0.78	4.22	3.05*	0.28
Intentions	4.02	0.66	4.17	3.70	0.74	3.67	4.98**	0.46
CC Attitudes in General	4.15	0.61	4.27	3.90	0.71	4.00	4.12**	0.38

*$p < .01$. **$p < .001$.
Cohen's *d* is interpreted as follows: small effect ($d = 0.2$), medium effect ($d = 0.5$), large effect ($d = 0.8$).

In the cross-national comparison, English students had significantly higher climate change knowledge. On average, they scored 6.98 out of a possible 8 points, compared to the lower scores of Czech and Portuguese students (both scored 5 out of 8). Significant differences were found for climate change attitudes. The highest score was achieved by English students (4.44), while lower scores were found for Portuguese students (4.03) and the lowest for Czech students (3.86). Significant differences were also evident in the sub-dimensions of the research instrument for climate change attitudes. The findings are summarised in Table 4.

Table 4
Comparison of Results for Each Dimension by Country

Research tools/ dimensions *M*	Czech Republic			United Kingdom			Portugal			*H*	Cohen's *d*
	SD	*Mdn*	*M*	*SD*	*Mdn*	*M*	*SD*	*Mdn*			
Climate change knowledge	5.00	1.72	5.00	6.98	1.47	8.00	5.00	1.80	5.00	120.84**	1.17
Environmental values and attitudes											
Preservation	3.76	0.76	3.89	3.86	0.72	4.00	3.76	0.81	3.89	1.26	.11
Utilisation	2.43	0.74	2.43	2.24	0.64	2.14	2.45	0.75	2.57	6.27*	.23
Appreciation	3.53	1.09	3.60	3.58	1.06	3.60	3.84	0.97	4.00	2.99	.15
Willingness to Act	3.56	0.95	3.67	3.71	0.89	3.83	3.61	0.92	3.83	2.10	.13
Pro-environmental Behaviour	3.06	0.78	3.00	3.01	0.78	3.10	3.21	0.80	3.20	1.86	.13
Climate change attitudes											

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Research tools/ dimensions	Czech Republic			United Kingdom			Portugal			*H*	Cohen's *d*
M	*SD*	*Mdn*	*M*	*SD*	*Mdn*	*M*	*SD*	*Mdn*			
Climate change knowledge	5.00	1.72	5.00	6.98	1.47	8.00	5.00	1.80	5.00	120.84**	1.17
Beliefs	3.97	0.85	4.00	4.56	0.54	4.67	4.12	0.95	4.50	80.56**	.91
Intentions	3.70	0.68	3.67	4.26	0.61	4.33	3.88	0.86	4.08	61.55**	.77
CC Attitudes in General	3.86	0.62	3.87	4.44	0.51	4.60	4.02	0.86	4.20	84.77**	.94

*$p < .05$. **$p < .001$.
Cohen's *d* is interpreted as follows: small effect ($d = 0.2$), medium effect ($d = 0.5$), large effect ($d = 0.8$).

Correlations

Different significant correlations were found among the different dimensions of the tools used. At a significance level of $p < .05$, the expected correlations between close or interdependent dimensions (e.g., beliefs, intentions and climate change attitudes) were primarily significant. Other correlations between dimensions that are not directly interdependent are, however, also evident. In particular, the results of climate change attitudes in general and the sub-dimensions beliefs and intentions are significantly positively correlated with the climate change knowledge dimension. The dimensions environmental values and the attitudes nature conservation and appreciation of nature are significantly positively correlated with both pro-environmental behaviour and climate change attitudes. In contrast, the dimension utilisation of nature shows a weaker negative correlation with pro-environmental behaviour and a stronger negative correlation with climate change attitudes. Interestingly, there is a strong positive correlation of the willingness to act sub-dimension with the pro-environmental behaviour dimension. The correlations are captured in more detail in Table 5.

Table 5
Spearman's ρ Values for the Studied Dimensions

Dimension	1	2	3	4	5	6	7	8	9
1. Climate change knowledge	—								
2. Nature preservation	.14**	—							
3. Utilisation of nature	-.23**	-.36**	—						
4. Appreciation of nature	.07	.58**	-.26**	—					
5. Willingness to act	.12*	.957**	-.32**	.58**	—				
6. Pro-environmental behaviour	.08	.66**	-.21**	.59**	.67**	—			
7. Climate change beliefs	.46**	.48**	-.36**	.33**	.42**	.35**	—		
8. Climate change intentions	.39**	.52**	-.49**	.38**	.50**	.41**	.71**	—	
9. Climate change attitudes in general	.47**	.53**	-.45**	.37**	.48**	.40**	.94**	.90**	—

*$p < .05$. **$p < .01$.

Regression Analysis

Multiple linear regression analysis showed significant results concerning the dependent variables pro-environmental behaviour (Table 6) and climate change beliefs (Table 7).

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Table 6
Multiple Regression Analysis for the Effect of Selected Variables on Pro-environmental Behaviour ($R^2 = 0.54$).

Predictor	*β*	*t*	*p*
Utilisation of nature	-.13	-3.53	< .001
Age	-.10	-2.82	.01
Climate change knowledge	-.01	-0.82	.84
Climate change beliefs	.03	0.52	.60
Climate change intentions	.12	2.52	.01
Appreciation of nature	.33	8.43	<.001
Nature preservation	.42	9.19	<.001

R^2 – proportion of variance of dependent variable explained by the independent one. *β* – the degree of negative (-) or positive (+) change in the outcome variable for every unit of change in the predictor.

The regression analysis with the dependent variable pro-environmental behaviour shown among the variables studied, the relationship to nature and its protection has the greatest positive effect on students' pro-environmental behaviour. There is also a weak negative effect of utilisation of nature. Among attitudes towards climate change, intentions play a role, while beliefs are without an effect on behaviour. The effect of age is weakly negative, with older students showing lower values of behaviour.

Table 7
Multiple Regression Analysis for the Effect of Selected Variables on Climate Change Beliefs ($R^2 = 0.60$).

Predictor	*β*	*t*	*p*
Age	.03	0.74	.47
Appreciation of nature	.03	0.78	.44
Utilisation of nature	.06	1.57	.11
Nature preservation	.23	5.69	<.001
Climate change knowledge	.24	78.25	<.001
Climate change intentions	.49	112.21	<.001

R^2 – proportion of variance of the dependent variable explained by the independent one. *β* – the degree of negative (-) or positive (+) change in the outcome variable for every unit of change in the predictor.

Quite predictably, climate change intentions have the greatest effect on climate change beliefs. More interesting results are shown, however, by the multiple regression analysis for climate change knowledge, which also contributes significantly to climate change beliefs. The nature conservation dimension of the environmental attitudes and values tool also reaches similar values of effect on climate change beliefs.

Discussion

Students' knowledge and attitudes towards climate changed as documented by the research, are consistent with previously published data in terms of gender. While there was no apparent gender difference in knowledge, there was a significant difference between the higher scores of girls compared to the lower scores of boys on the other dimensions studied related to environmental and climate values, attitudes and behaviours. This was to some extent a constant of many previously published studies focusing variously on environmentalist issues (Galli et al., 2013; Činčera & Krajhanzl, 2013; etc.) or specifically on climate change (Dijkstra & Goedhart, 2012; Hermans & Korhonen, 2017; Stevenson et al., 2014; Stevenson et al., 2016). The present study thus complemented and refined the gender gap in the context of climate education in European countries, in line with previously published data from other contexts.

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This phenomenon could be explained in part from a psychological perspective, with girls being more sensitive to processes that could affect different areas of human life (Goldin et al., 2019; Holvoet & Inberg, 2014; McCall et al., 2019).

In international comparison, there was a striking difference in climate change knowledge, which is higher in the United Kingdom and lower in the Czech Republic and Portugal. In the Czech context, the earlier nature of the Czech public debate on climate change, which was lagging behind the Western European countries, offered an explanation for this phenomenon. At a time when a large number of European countries were already discussing mitigation measures, the Czech public sphere was characterised to a greater extent by a discussion about whether climate change was taking place at all. In doing so, it is true that top political representatives have a significant influence on the public's views on specific topics. They also influenced, however, the polarisation of opinion groups, which they could dampen or intensify depending on the nature of their speech (Kousser & Tranter, 2018). The situation was gradually changing in the Czech Republic as well, however, influenced by the rapid growth of global public debate and research in climate change education (Nepras et al., 2022). Information about climate change and the factors that caused it was gradually becoming part of the educational curriculum at all levels of education. This was also linked to an improvement in the awareness of Czech teachers and a gradual transfer of knowledge from teachers to students (Miler et al., 2012). This trend was indicated in several studies (Jurek et al., 2022; Kolenaty et al., 2022). The trend in curriculum change was also indicated in more general terms by Curin and Mikolasikova (2021). It could be inferred and assumed from this that curriculum trends in different educational areas also followed a pro-environmental knowledge base. This may lead to improved knowledge about climate change. Although there might currently be significant differences in climate change knowledge among children across countries, there was hope for a gradual closing of the gap with the application of effective educational approaches. In this sense, longer-term interactive democratic learning with constructivist elements and significant levels of student participation could be considered effective teaching strategies (Cutter-Mackenzie & Rousell, 2018; Deisenrieder et al., 2020; Keller et al., 2019; Reis & Ballinger, 2018; Trott, 2019).

Regression analysis showed the significant effect of some of the observed dimensions on pro-environmental behaviour and climate change beliefs. The direct effect of climate change knowledge on pro-environmental behaviour was not demonstrated in this study, while Svobodova and Chval (2022) documented a positive dependence of pro-environmental behaviour and environmental attitudes on environmental literacy directly from the Czech Republic. This was consistent with the effect we identified for nature preservation utilisation and appreciation. In contrast, our results showed a significant effect of knowledge on climate change beliefs. A similar result was reported by Tasquier and Pongiglione (2017), who linked their findings to scientific knowledge on climate change, which, according to the authors, allowed students to understand the impact of problematic human activities on their environment, not only in the short term but also in the long term. There were multiple studies supporting the above results (Castillo & Nozaleda, 2022; Stevenson et al., 2016; etc.).

The dimensions of nature preservation and appreciation of nature stand out as the most significant predictors with a positive effect on pro-environmental behaviour. Other authors have obtained similar results in other contexts, for example among adults in rural American communities (Takahashi & Selfa, 2014) or Spain (Casalo & Escario, 2018). Climate change intentions stand out as a weak positive predictor of pro-environmental behaviour. Kim and Jeong (2012) also presented similar results demonstrating the influence of several climate-related predictors on pro-environmental behaviour concerning American and Korean students. It seemed plausible that the relationship between the reported dimensions of environmental attitudes and values and pro-environmental behaviour was valid not only in the context we studied but also in other nearby contexts.

Of the predictors, the nature preservation dimension had a significant positive effect on climate change beliefs, in addition to climate change knowledge and the climate change intentions dimension. The result was also interesting in the context of the finding that the appreciation of nature dimension did not stand out as a significant predictor in our research. It was possible to consider that the nature preservation dimension was closer to personal values, which was a documented predictor of climate change beliefs (Karpudewan, 2019) and thus had a more significant effect on climate change beliefs.

The knowledge had not got statistically significant effect on pro-environmental behaviour. This finding is in contradiction with results presented in other studies like Reis and Ballinger (2018); Stevenson et al. (2014) or Keller et al (2019). I could be caused by not so appropriate learning process in Czech Republic and Portugal, where the lack of kinds of information about connection between knowledge, behaviour and attitudes is obvious. The education system in United Kingdom is more inclined into climate change with all aspects, but it is not sufficient to manifest significant effect.

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Limitations

We are aware of the limitations of the research presented. The most significant limitation is the selection of respondents, where the sample of respondents available to us was used. Thus, the results must be interpreted with this limitation in mind and seen as a pilot, where it seeks to highlight certain trends and the applicability of the research tools. A study on a representative sample from more countries should follow. A limitation is also the disproportion in the number of respondents from each country, which we have eliminated by using appropriate statistical methods (Bartlett's test, Kruskal-Wallis test). A limitation is also the use of quantitative tools to monitor pro-environmental behaviour, which should be seen as declared rather than observed.

Conclusions and Implications

The presented results pointed to the actual problems with perception of climate change from the view of primary school students. It was found a relatively large number of factors, which influenced the perception of climate change. Gender had a significant effect on every dimension, with a higher score dominating among boys. The effect of country was significant only in a small number of dimensions. The Pro-environmental Behaviour and Climate Change Beliefs are influenced by Nature Preservation and Utilization of Nature. This study also provided the findings, which predictors caused climate change attitudes. This observation created the possibility, that precursor of climate change attitudes could be sample or nation specific. A recommendation, which resulted from the findings is to replicate research among other nations and cultures. Based on the presented results, it will be important to carry out further research with a focus on other factors that may have an effect on students' climate change knowledge and attitudes. A possible factor could be the different age groups of respondents from kindergarten children to university students. A significant factor could also be the school perception of respondents, because schools are an important factor to create the perception of the world by pupils and students. Educative strategies could be also implemented to improve preventive and protective behaviour toward climate. The improving of climate change attitudes could be caused by implementation of non-traditional learning methods like for example storylines and visuals. It is obvious, that educational world contains many other forms and methods, which could serve as precursors of to minimize climate change.

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Declaration of Interest

The authors declare no competing interest.

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Appendix 1

Demographics

A1 I am: girl/boy.
A2 How old are you?
A3 What grade are you in?
A4 What is the name of the school you go to?

Climate change knowledge

1.1 Taking a plane when going on vacation has a greater impact on the environment than riding a train.
1.2 Carbon dioxide generated by the combustion of coal in coal-fired power plants may affect the climate of our planet.
1.3 Nuclear power plants release more carbon dioxide into the atmosphere than coal-fired power plants.
1.4 The climate of our Earth has been warming in recent decades. One of the causes of this warming is human activity.
1.5 When a school class goes on a trip in six cars, it will have less impact on the environment than if the entire class takes one bus.
1.6 Cutting down tropical rainforests in Africa cannot have a significant impact on climate change in Europe.
1.7 The warming of the Earth's climate is causing ocean levels to rise as water from melting glaciers increases.
1.8 Wind and solar power plants generate large amounts of carbon dioxide.

Environmental values and attitudes

2.1 When people interfere with nature, it often leads to disasters or very bad consequences.
2.2 People treat nature badly.
2.3 If we all continue doing things the way we do now, we will soon face a major environmental catastrophe.
2.4 If I had any extra money, I would give it to an organisation focusing on conservation of nature.
2.5 I would help raise money to protect nature.
2.6 I try to tell others that nature is very important.
2.7 When I have a choice, I prefer to drink tap water rather than bottled water purchased in a store.
2.8 If I have the opportunity, I will participate in an event organized by local nature conservationists.
2.9 If I have the opportunity, I will rather buy more environmentally friendly food, even if it costs more money.
2.10 People have the right to improve and change their environment (nature) to their advantage.
2.11 Building new roads is so important that it justifies cutting trees to make room for new roads.
2.12 Mosquitoes live in swamps and therefore swamps should be drained and used for agriculture.
2.13 In order for people to have enough food, a wild habitat must be transformed into agricultural fields.
2.14 People must rule over nature.
2.15 Weeds should be killed because weeds take up space for the plants we need.
2.16 I prefer a well-kept lawn to a meadow where the grass grows wild.
2.17 I like to watch and listen to birds.
2.18 Sometimes I stop, and just look at the clouds.
2.19 Sometimes I watch the stars at night.
2.20 Sometimes I take a moment and go smell the flowers.
2.21 It always calms me down when I listen to the sounds of nature.

Pro-environmental behaviour

3.1 I sort paper at home or at school
3.2 When I am the last to leave the room, I always turn off the light.
3.3 When I see people behaving badly towards nature, I immediately tell them.
3.4 In my free time, I watch TV or Internet broadcasts focusing on nature and the environment.
3.5 I talk to my parents about the possibilities that could help us solve environmental problems.
3.6 I also try to help with environmental issues at our school.
3.7 In my free time, I get involved in events that focus on protection of nature.
3.8 I often read about nature and the environment.

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3.9 I keep the refrigerator door closed until I decide what I want to take out from the fridge.
3.10 I hang birdhouses or feeders near my home.

Attitudes towards climate change

4.1 I believe that our climate is changing.
4.2 I am concerned about the global climate change.
4.3 I believe that there is evidence supporting the fact that the global climate is changing.
4.4 The global climate change will affect our environment in about 10 years.
4.5 Global climate change will affect future generations.
4.6 Activities of individuals may have a positive effect on global climate change.
4.7 Human activities are causing global climate change.
4.8 Climate change has a negative impact on our lives.
4.9 Our behaviour and actions can stop climate change.
4.10 I can help make the world a better place for future generations.
4.11 It is important for me to have knowledge of environmental problems.
4.12 I think environmental concerns are exaggerated.
4.13 The things I do have no effect on the quality of the environment.
4.14 Trying to solve environmental problems is a waste of time.
4.15 There are many things I can do to help solve environmental problems.

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