Exploring the effects of a classroom-based climate change intervention on secondary students in Ireland

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To Anu, for meaning, purpose and the opportunity to experience both with love and hope.

Abstract

Exploring the effects of a classroom-based climate change intervention on secondary students in Ireland

Objective: This research considers the degree to which participation in an 8–10-hour interactive climate change education (CCE) module affects secondary school students' knowledge, attitude, behaviour, and values about climate change.

Methods: This study utilises a one-group pre-, post-, and six-month follow up test repeated measures design, with 82 students (ages 12-15). The CCE programme is the independent variable. The dependent variables included self-reported pro-climate behaviours, climate behaviour intentions, environmental efficacy, worry about climate change and environmental values. Baseline and post-test measurements were completed by September 2022 and a follow-up assessment was completed by January 2023.

Results: Preliminary results show significant positive effects within the experimental group in relation to positive attitudes towards climate change behaviour, climate change behavioural intentions and climate change knowledge. Biospheric values also increased while egotistical values decreased significantly. The six-month follow-up suggests additional intervention may be needed to maintain positive effects.

Conclusion: Findings support the short-term effectiveness of the CCE programme as a useful educational intervention to promote climate change knowledge, environmental behaviours and biospheric values among groups of secondary school students. Follow up surveys suggest limited lasting effects in the medium term, with the exception of changes in egotistical values.

Declaration

I hereby declare that this thesis represents my own work and has not been submitted, in whole or in part, by me or any other person for the purposes of obtaining any other qualification.

Name : James Groarke

Signature: 

Date: 22nd April 2023

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Abbreviations

ANOVA	Analysis of Variance
APA	American Psychological Association
CCE	Climate Change Education
CSPE	Civic, Social and Political Education
CSV	Comma Separated Value
CO_2	Carbon Dioxide
DEIS	Delivering Equality of Opportunity in Schools
ESD	Education for Sustainable Development
EPA	Environmental Protection Agency
EU	European Union
GHG	Greenhouse Gases
IPCC	Intergovernmental Panel on Climate Change
KSM	Knowledge Structure Model
NCCA	National Council for Curriculum and Assessment
NEP	New Environmental Paradigm
PEB	Pro-environmental Behaviour
PCB	Pro-Climate Behaviour
PSI	Psychological Society of Ireland
PICO	Population Intervention Comparator Outcome
SPSS	Statistical Package for the Social Sciences
TPB	Theory of Planned Behaviour
UNESCO	United Nations Education, Scientific, Cultural Organisation
UNDP	United Nations Development Programme
VBNM	Value Belief Norm Model of Behaviour
WG1	Working Group 1 of the Intergovernmental Panel on Climate Change
WG2	Working Group 2 of the Intergovernmental Panel on Climate Change
WG3	Working Group 3 of the Intergovernmental Panel on Climate Change

1 Introduction

The sixth Intergovernmental Panel on Climate Change report (IPCC, 2021), released in August 2021, has warned of unprecedented, irreversible changes to the environment and that, unless largescale, meaningful action is taken, the world is currently geared towards catastrophic global warming. This report highlights what IPCC scientists call a "Code Red for humanity", brought about in large part by the consumption and behavioural patterns of the wealthiest countries in the world, of which Ireland is included (IPCC, 2021). Some of the behaviours highlighted in the report include dietary, transport and energy use patterns while the report also noted that immediate change is necessary in order to ameliorate the worst effects of climate change. This signifies that the leaders in global consumption and emissions production need to learn new knowledge and skills and make significant behavioural changes in order to mitigate the risks associated with climate change and to minimise systemic vulnerabilities to those risks.

Climate scientists advocate for change to occur at the international level between nations, at the national level through state policy in different sectors, at non-state level through transnational entities, and at the individual or household level (Working Group III of the IPCC, 2022). In terms of the need for change, the IPCC currently advocates for net zero CO_2 emissions from the industrial sector, a drastic reduction in methane emissions from the agricultural sector by 2030, the deployment of low emission energy sources to lock in greenhouse gases by the energy sector, and the development of national and local level policies that shift development towards sustainability amongst others (IPCC, 2022). The 2022 IPCC report also notes the important and growing role that grassroots and non-state entities play in mitigation and adaptation efforts towards addressing climate change at the micro level, mentioning local community organisations, businesses, youth groups, labour organisations, and the media amongst others (IPCC, 2022, p. 59). A review of the literature

also notes how individual and community based, environmental behavioural change can be an important factor in mitigating anthropogenic climate change (Dietz, Gardner, Gilligan, Stern, & Vandenbergh, 2009). This is primarily due to the fact that individual consumer behaviour patterns concerning food, shelter, and transport account for upwards of 70% of greenhouse gas emissions when full production cycles are considered (Dietz, Gardner, Gilligan, Stern, & Vandenbergh, 2009). This is not to say that individuals should feel responsible for the occurrence of climate change, however. Roughly 100 corporate and state-owned fossil fuel companies are currently responsible for 70% of global emissions (Hyman, 2020) and any actions taken by individuals globally should be seen as part of a bigger collective picture aimed at encouraging state and corporate emitters to improve their environmental credentials.

Both international (UNESCO, 2020; IPCC, 2022) and national (Dept of Education and Skills, 2014) entities agree that education at both primary and secondary level can act as a contributor to positive changes in environmental behaviours. Indeed, Article 6 of the United Nations Framework on Climate Change highlights how countries should consider education, training, public awareness, and public access to information as at the core of any country's response to climate change (Mochizuki & Bryan, 2015). Educational psychology can play a pivotal role in improving our understanding of environmental attitudes and behaviours demonstrated by students as a result of climate change education. Similarly, educational psychologists are well placed to consider the different personal and social factors such as values, knowledge, coping strategies and efficacy levels that are known to affect environmental behaviour (Ojala, 2005). This in turn will assist societies in encouraging a paradigm shift towards biospheric thinking, a philosophy that recognises the interconnectedness and interdependency of humans with all species within a world of limited resources. A move towards such biospheric values will incorporate changes in both lifestyle

and consumer behaviours (Gowdy, 2008; Anderson, 2013) as well as broader structural, cultural, perceptual, and ideological shifts that aim to balance economic growth with the needs of the planet (Mochizuki & Bryan, 2015). These attitudinal and behavioural shifts have so far been limited however, because of the complexity of understanding climate change (Anderson, 2012; Truelove & Parks, 2012), the role that political and economic elites have played maintaining a focus on individual attitudes and behaviours at the expense of collective attitudes and behaviours (Hyman, 2020), the lack of effective knowledge on how to mitigate personal behaviours that affect climate change (Frick, Kaiser, & Wilson, 2004) and also because of the difficulty in changing habitual climate change causing behaviours that are considered norms in Western societies (Stern, 2000).

The first chapter of this thesis consists of a systematic review of the literature related to the effects of climate change education section. This includes an outline of the context and rationale for undertaking a review on this area. It also includes an overview and a critique of different theories related to the topic. The third and fourth parts of the first chapter outlines and discusses the findings of the impact of environmental education on pro-environmental behavioural and attitudinal changes. The review ends with suggested directions for future research to further strengthen the role of climate change education in pro-environmental behaviour change.

The second chapter of this study introduces a piece of original research – the impact of a climate change education (CCE) intervention on secondary school students in Ireland. This chapter also includes the context through which this intervention was delivered as well as a description of the intervention and the rationale for how it was developed. The chapter then moves into the methods used for the interventions delivery and presents a set of results. It ends with a discussion of these results together with some ideas about how this research might impact our current thinking about CCE.

The third and final chapter of this study includes a critical review and impact statement in relation to the piece of research carried out. This chapter highlights some of the strengths and limitations of the methodology of the study. It also discusses some of the ethical issues that were considered prior to starting the study. The chapter then discusses a series of implications that relate to the education sector, the field of psychology and to Irish society at large. The chapter ends with a statement explaining the researcher's ideas of who the research might impact and the manner in which it will affect them.

This study follows the hypothetico-deductive method of research that is common within the field of applied psychology (Barker, Pistrang, & Elliott, 2002). Reflecting the pragmatic paradigm within which the research takes place, the study is based on two widely accepted theories related to environmental behaviour, the Value Belief Norm model (Stern, 2000) and the New Environmental Paradigm (NEP) (Dunlap, Van Liere, Mertig, & Jones, 2000; Bernstein & Szuster, 2019).The NEP promotes biospheric values insomuch as it espouses valuing and respecting the natural world above all else by maintaining a pro-environmental orientation (Davis & Stroink, 2015). In terms of study design, this study is quasi experimental in nature as it involves testing whether a climate change education intervention designed by the research had an effect on a series of outcomes, namely environmental values, pro-environmental and climate change related behaviour, as well as knowledge and attitudes related to climate change. While efforts to recruit and use a control group were attempted the methodology eventually settled on involved measuring changes to variables within a single group over three points in time – pre intervention, post intervention and at a 6 month follow up period. Figure 1 provides a visual map to the structure of the thesis.

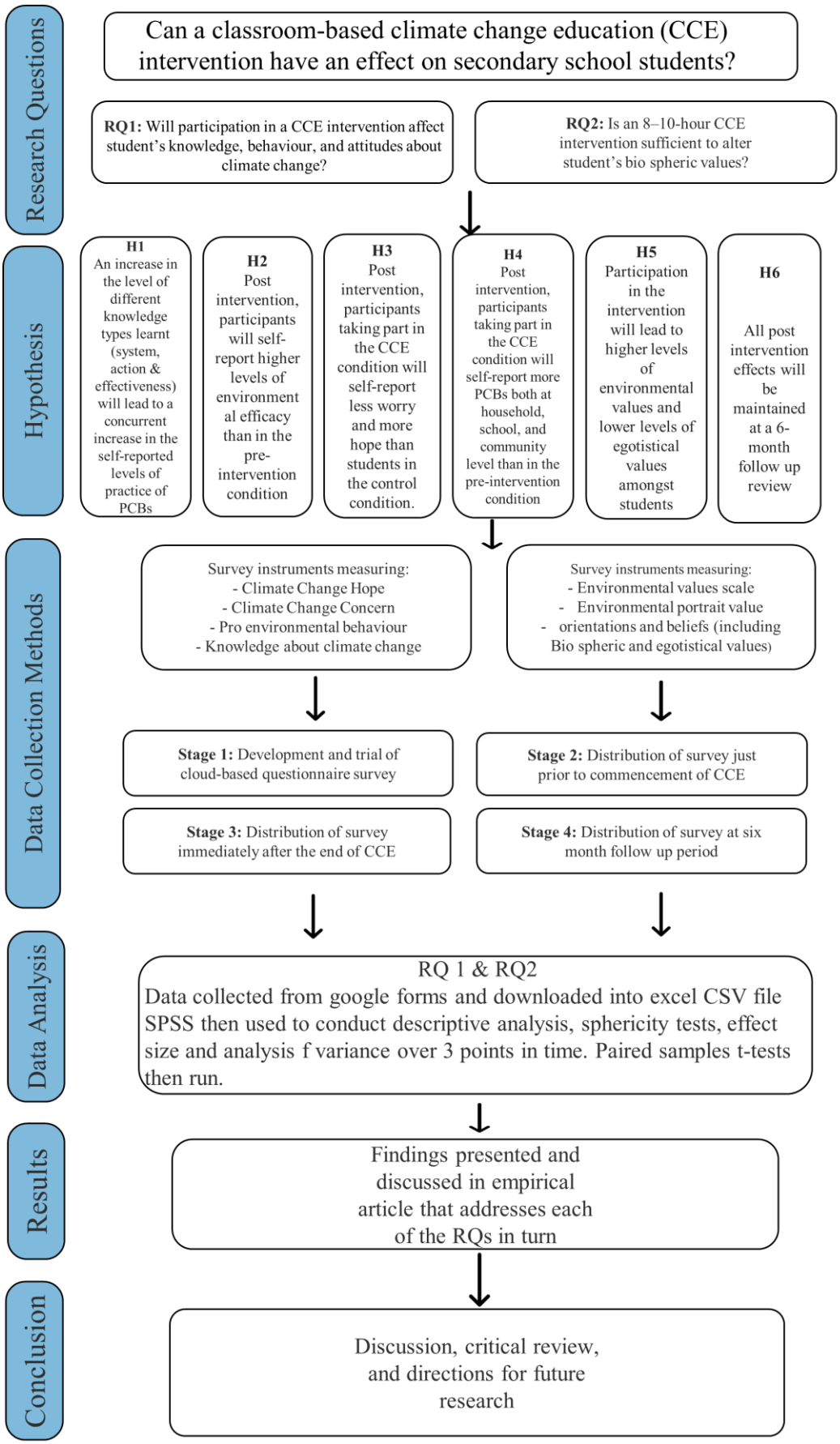


Figure 1: Overview of thesis structure

2 Literature Review

The outcomes of climate change education for primary and secondary aged children: a systematic review of quantitative research.

2.1 Context and rationale

Since the commencement of the global climate justice strikes organised by Fridays for Future in 2018 (Future, 2019), school pupils and students have been at the forefront of climate justice activism on the streets (Strike, 2021) and in the courts (Planet, 2020). This reflects what Corner et al. (2015, p523) call the "unique position" that young people today face with regard to anthropogenic climate change: they have both the most to gain and the most to lose from the political decisions currently being made to mitigate climate change. A large body of research has captured the changing nature of young people's attitudes towards climate change over the past forty years (Lee, Gjersoe, O'Neill, & Barnett, 2020). Up to date research has shown how, within the EU (Commission, 2020), Australia (Institute, 2020) and the USA (Krosnick & Macinnis, 2020), at least 80% of young people view climate change as the most serious problem facing both their countries and the world. Reflecting this, influencing environmental policy is one of the largest areas of activism for EU youth engagement (Stiftung, 2020). Indeed, a recent, large-scale survey by the United Nations Development Programme suggests that 65% of young people think that climate change is an emergency requiring much wider reaching environmental policies than states currently espouse (UNDP & Oxford, 2021).

These attitudinal changes in relation to climate change have also led to a growing awareness of the need for concrete action on many levels and in many areas of life. This relates to the intersectional nature of the climate change issue, encompassing as it does areas as diverse as energy, education, inequality, globalisation, trade, poverty, agriculture, diet, and transport. Consequently, tackling climate change entails making choices about different

transition pathways which involve widespread engagement with and actions by both the government and citizens of a state (McNally, 2020), not to mention corporate (Ihlen, 2009) and other supranational entities (Hormio, 2017). At an international level, the United Nations Education, Scientific and Cultural Organisation (UNESCO) highlights the different policy areas through which states can act in order to "understand, address, mitigate and adapt to the impacts of climate change" (UNESCO, 2010, p. 4). Many of these involve long term cooperative actions between states, such as the United Nations Framework Convention on Climate Change (United Nations, 1992) whose signatories, including Ireland, aim to stabilise greenhouse gas concentrations "at a level that would prevent dangerous anthropogenic interference with the climate system" (United Nations, 1992, p9). At a national level, states such as Ireland have developed their own climate change policies (Dept of Communications, Climate Action and Environment, 2019), Climate Action Plans (Dept of the Environment, Climate and Communications, 2021) and laws such as the Climate Act 2021 aimed at the gradual reduction of human caused emissions. Education for sustainable development policies (Dept of Education and Skills, 2014) have also been introduced, through which students learn about the need to balance economic, social and environmental considerations (Nevin, 2008) while ultimately acquiring responsible environmental behaviours (Sia, Hungerford, & Tomera, 1986; UNESCO, 2020).

Researchers have also examined the extent to which individual household behaviours contribute to climate change, particularly in Western countries where household consumption is much higher (Hertwich, 2005; Dietz, Gardner, Gilligan, Stern, & Vandenbergh, 2009). When considering the life-cycle impacts of consumer products and services, Hertwich and Peters (2009) as well as Tukker and Jansen (2008) identify at least 70% of all carbon dioxide emissions from the U.S as stemming from the household consumption of food, housing and transport products. Ireland's Environmental Protection Agency (EPA, 2019) identifies

roughly 45% of greenhouse emissions as coming from housing, transport, and energy industries, both commercial and home (See Figure 2).

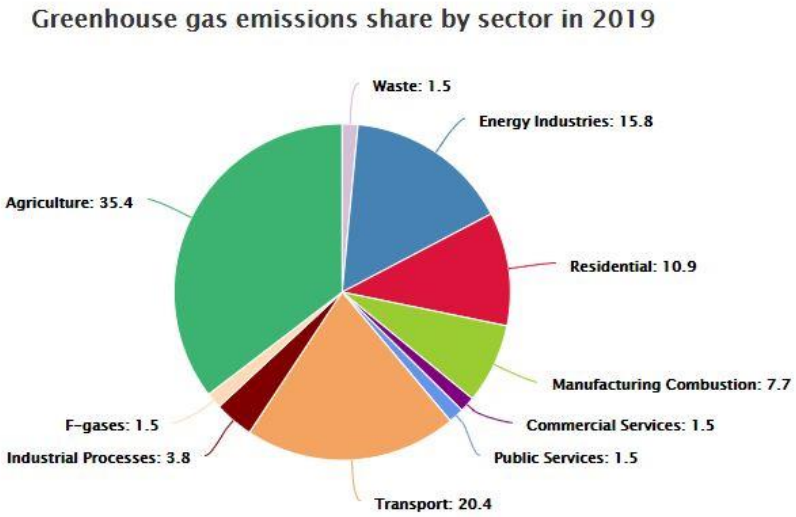


Figure 2 Origin of Ireland's greenhouse gases (EPA, 2019)

Klochner (2013, p. 1028), argues that it is crucial for individuals to "acknowledge and accept that individual behaviour both significantly contributes to global environmental challenges and that individual behaviour change has the potential to reduce this significantly". Taylor and Watts (2019) contend that this in no way abrogates the role that the state and the corporations themselves should play in encouraging fossil fuel companies and other major emitters to change corporate behaviours. Griffin, Heede, and van Der Vlugt (2017) agree with this perspective as it maintains a focus on the primary greenhouse gas emitters rather than placing responsibility on the shoulders of the consumers themselves. Dietz et al's study (2009) highlights individual behavioural patterns affecting the environment as dependent on three factors: the impact that the behaviour has, the number of people who perform the behaviour, and the percentage of people who are willing or able to change a given behaviour. Dietz et al's study (2009) also estimates that scaling up 17 of the most effective non-regulatory interventions could reduce carbon emissions from direct household energy use by 20% in 10 years. Many of these interventions consist of simply

flicking a switch or changing a timer, for instance not using standby mode on TV's or Laptops, reducing the laundry temperature by 10 degrees, or walking to school instead of taking the car. While increasing awareness of these behavioural changes will not mitigate anthropogenic climate change, it does serve to complement the primary mitigation efforts taken at state and supra-state levels, while also potentially increasing pro-environmental attitudes and behaviour in the public at large, leading to less tolerance by the public of state or industrial-scale emissions. It is hoped that an increase in awareness of effective behavioural changes will also increasingly allow young people to switch their awareness away from dysfunctional emotion or avoidance focused coping strategies. Such strategies might include unproductive wishful thinking that technology will allow current environmentally destructive patterns of consumption to continue or long-term disengagement from the problem because of the negative emotional import that it contains for the person (Zeidner & Endler, 1996). It is hoped that the current research will allow young people in Ireland to move towards more problem or meaning focused solutions (Ojala, 2012) where young people themselves accept responsibility for solving the problem, seek accurate information and help to solve the issue of climate change in their own spheres of action while also maintaining an optimistic view of humanities capacity to solve the problem.

2.1.1 Educational context in Ireland

The Department of Education released their first strategy paper considering climate change in July 2014 (DES, 2014). This paper addressed the topic of climate change through the lens of sustainable development education, a perspective that has both its supporters (Mochizuki & Bryan, 2015) and detractors (Jorgenson, Stephens, & White, 2019; Monroe, Plate, Oxarart, Bowers, & Chaves, 2017; Wade, 2014). Echoing this, the State's first strategy paper aimed to identify where climate change could be discussed within the current

syllabus, rather than a focus on establishing a climate change module, course or project at different levels. Policy papers document how climate change and sustainability can be identified as being embedded at different levels through "Citizenship" values (NCCA, 2022b, p. 11). At a primary level learning to care for each other and the environment is emphasised in *Aistear: The Early Childhood Curriculum Framework* (NCCA, 2009). Being an active citizen who "lives justly, sustainably and with regard for the rights of others" is also recognised as one the key competences of the Draft Primary Curriculum Framework (NCCA, 2020, p. 8) while the rationale for the introduction of a new curriculum includes mentions of global challenges such as climate change, sustainability and the impact that they can have on childhood (p3). The Framework for Junior Cycle (DES, 2015) also discusses climate change through a cross-curricular approach aimed at integrating sustainability within subjects as diverse as science, home economics, geography, and wood technology. The Civic, Social and Political Education (CSPE) short course also examines global citizenship through climate change and climate action. While the above points highlight ways in which learning related to climate change can be found at different curricular levels, generally through sustainability and citizenship values, the cross-cutting nature of climate change in the curriculum means there is very little in the way of formal material specific to climate change within the programme. This led to accusations within the media that climate change was being left up to individual teachers to enhance students' capacity to make meaningful changes in their lives and the lives of their communities (Boland, 2022). In June 2022, the various State departments took further steps to address the lack of a systemic and systematic response to climate change within the education system in Ireland through the release of the Second National Strategy on Education for Sustainable Development (Government of Ireland, 2022). This strategy recognises the key role that young people play as contributors to Ireland's sustainable future and suggests different actions that can be taken to ensure that young

people's voices are heard in relation to climate change policy (Government of Ireland, 2022). A part of this policy was the announcement by the Minister for Education in March 2022 of the need for a stand-alone subject concerning climate change (NCCA, 2022a) and the publication of a background paper on the development of a new leaving cert subject entitled Climate Action and Sustainable Development to be introduced at senior cycle level in September 2024 (NCCA, 2022b). Research undertaken by UNESCO forms the core rationale for the introduction of this topic, with the following areas being identified within the NCCA's policy document (NCCA, 2022b):

- Nearly half of national curriculum frameworks had no reference to climate change.
- 88% of the curricula that did mention climate change had a minimal or very minimal focus on the topic.
- Climate change education needs to be integrated across all levels and disciplines of learning.
- Climate change education needs to incorporate action focused learning with equal importance places on "head", "heart" and "hands" through holistic curricula and pedagogies (see figure 3) (UNESCO, 2020; UENSCO, 2021).

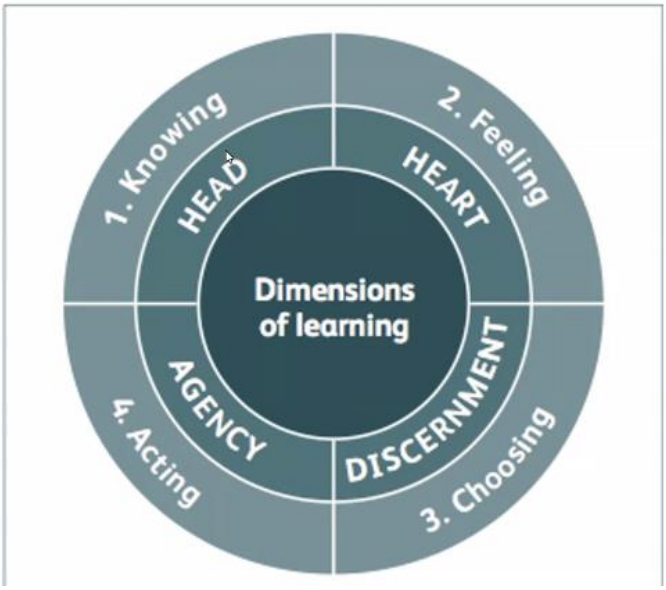


Figure 3: Four dimensions of learning about climate change (Hicks, 2019, p. 23)

Where students do learn about pro-environmental behaviour it is often through externally funded programmes such as the Green School's initiative (Thompson, 2017). This programme aims to foster environmental awareness through encouraging school wide change based on a number of different themes such as littering, water use and travel (An Taisce, 2016). Each of these themes is considered through the establishment of a school wide committee, a review of the current situation, the development of an action plan and the submission of the actions undertaken in order to receive a Green Flag award. Recent research (Monus, 2022) suggests that a school identifying as a green school or not had little impact on the behaviour of the students within that school. Water and energy conservation behaviour within schools, identifying as green or otherwise, only increased if there was a heavy focus in all classes at all times on climate change or environmental behaviour.

2.2 Behavioural theories and models

Prager (2012) notes how some theories and models are well suited for a heuristic understanding of environmental behaviour through their inclusion of a wide variety of the different variables that influence choices and behaviour. These are generally integrative theories of behaviour insomuch as they incorporate both internal, psychological factors with external, social, or economic behaviour determinants. Appendix 5 holds a concise review of the different theoretical models applicable to climate change education with the most pertinent models discussed in the section below.

2.2.1 New Environmental Paradigm

In contrast to the values of individualism, material abundance and the goodness of economic growth which has been labelled the Dominant Social Paradigm (Pirages & Ehrlich, 1974; Davis & Stroink, 2015; Dunlap, 2008) and based on an awareness that the continued existence of western industrial society is threatened by the uncritical acceptance of such a paradigm (Pirages & Ehrlich, 1974) Dunlap and Van Liere developed the New

Environmental Paradigm (NEP) in the late 70's as an environmentally aware counterpoint to the then current DSP. The NEP reflects an "implicit cognitive tendency to value and respect nature as well as to acquire and maintain a pro-environmental orientation" (Davis & Stroink, 2015, p. 578). The NEP includes environmental concern, defined as the affect a person experiences when considering environmental problems, attitudes which refer to the collection of beliefs and intentions a person holds towards the environment and environmental worldview which is a person's belief about humanity's relationship with nature (Schultz, et al., 2005) (Dunlap, Van Liere, Mertig, & Jones, 2000). A scale to measure the construct of NEP was developed and revised by Dunlop and colleagues, most recently in 2000 (Dunlap, Van Liere, Mertig, & Jones, 2000). The NEP is now used widely in the field of environmental psychology and has been positively associated with environmental identity, connectedness to nature, biospheric values, and pro-environmental behaviours (Davis & Stroink, 2015). Similarly, the NEP is closely associated with the Value-Belief-Norm Theory of Environmentalism proposed by Stern (2000) in the sense that a person's values, concerns for the environment and effective knowledge level can all affect their PEB (See Figure 4).

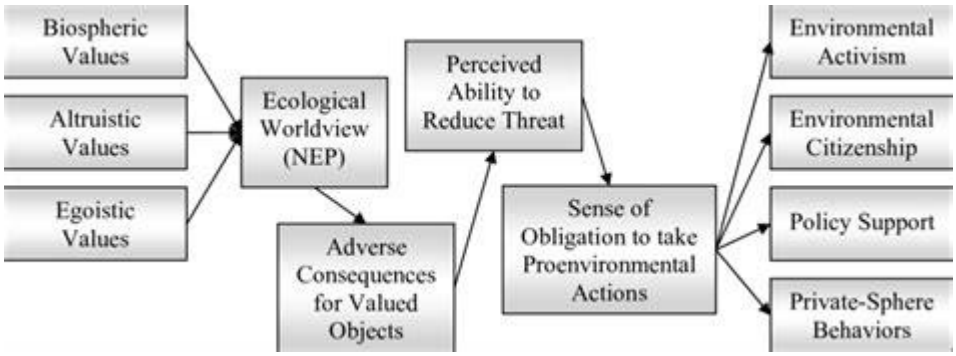


Figure 4: The Value-Belief-Norm Theory of Environmentalism (Stern, 2000)

2.2.2 Knowledge structure model

Some of the most recognised theories of environmental behaviour (Kollmuss & Agyeman, 2002; Ajzen, 1991) recognise the role that knowledge plays in environmental change but see it as a minor, indirect variable in comparison to intention in the TPB (Azjen &

Fishbein, 1980) or values and norms in the BVM (Stern, 2000) theory. In contrast, other researchers have identified that a lack of knowledge about the causes of climate change is often cited as a reason for not acting environmentally (Truelove & Parks, 2012). This has led to the Knowledge Structure Model (KSM) which highlights the three different types of knowledge which impact environmental behaviour (Frick, Kaiser, & Wilson, 2004). Frick et al. highlight how system knowledge is the form of knowledge most commonly considered when teaching about climate change. System knowledge focuses on considering how different variables within a system relate and interact with each other, such as how methane produced by cows causes an increase in global temperatures. Despite being the focus of climate change education, system knowledge plays the smallest role in determining pre-environmental behaviour (Bofferding & Kloser, 2015). Action knowledge, the second form of knowledge, represents how a person comprehends what type of action or behaviour might influence a given environmental situation. Action knowledge is similar to the competence aspect within the Competence Model for Environmental Education (Roczen, Kaiser, Bogner, & Wilson, 2013; Kaiser, Roczen, & Bogner, 2008). Within the climate change context this might be a student understanding that consuming local produce leads to a smaller carbon footprint which in turn leads to less of an impact on the climate in general. As this type of knowledge is more proximate to environmental behaviour and can occur without the need for any clear systemic knowledge, it is considered as having a greater impact on pro-environmental behaviour (Frick, Kaiser, & Wilson, 2004; Smith-Sebasto & Fortner, 1994). The third type of knowledge required to understand environmental behaviour is effectiveness knowledge. This addresses the relative gain that is associated with a given behaviour. This third type of knowledge is important because it moves from the "how to" of action related knowledge to "how to get the greatest environmental benefit" of effectiveness knowledge. UNESCO regards effective climate change awareness strategies as including the

aforementioned three strands of knowledge. The UNESCO climate change informational material can be broken down into understanding:

1. System Strand: What the climate change and the greenhouse effect are
2. Action Strand: How human behaviours can impact, mitigate and adapt to climate change
3. Effectiveness Strand: Which behaviours are most effective in meeting a particular mitigation or adaption goal (UNESCO, 2010).

The current research looks at pro-environmental behaviour amongst adolescent populations. While the behavioural models above draw parallels between different personal and contextual factors and behaviours amongst adults, there are currently no systematic reviews which specifically consider factors influencing environmental behaviours among a younger population (Balunde, Perlaviciute, & Steg, 2019). As it is well known that adolescents' identities are in a state of flux and development throughout their teenage years (Balunde, Perlaviciute, & Steg, 2019; Wigfield, Byrnes, & Eccles, 2006; Carr, 2016), it is worthwhile asking whether the factors affecting young people's environmental behaviours are similar to adults. As one European study notes (Balunde, Perlaviciute, & Steg, 2019, p. 1), such knowledge is necessary to develop evidence-based, age-tailored policies and programmes to foster young people's pro-environmental behaviour. The current study used the model of pro-environmental behaviour developed by Kollmuss and Agyeman (2002) as a framework through which to consider PEB factors and outcomes (see figure 5). This model is useful for the manner in which it considers both external and internal factors as well as barriers to pro-environmental behaviour (PEB). This model is particularly relevant as recent research suggests that, by themselves, internal factors such as knowledge, belief, and motivation explain roughly only 65% of the variances in the formation of climate conserving behaviours (Ali Khan, Karpudewan, & Annamalai, 2021). The different factors considered

from each reviewed paper were further categorised based on a list of determinants of environmental behaviour developed by Michie et al. (2008). Kollmus and Agyeman (2002, p. 40), define pro-environmental behaviour as "behaviour that consciously seeks to minimise the negative impact of one's actions on the natural and built world" which is the definition that will be used for the purposes of this research.

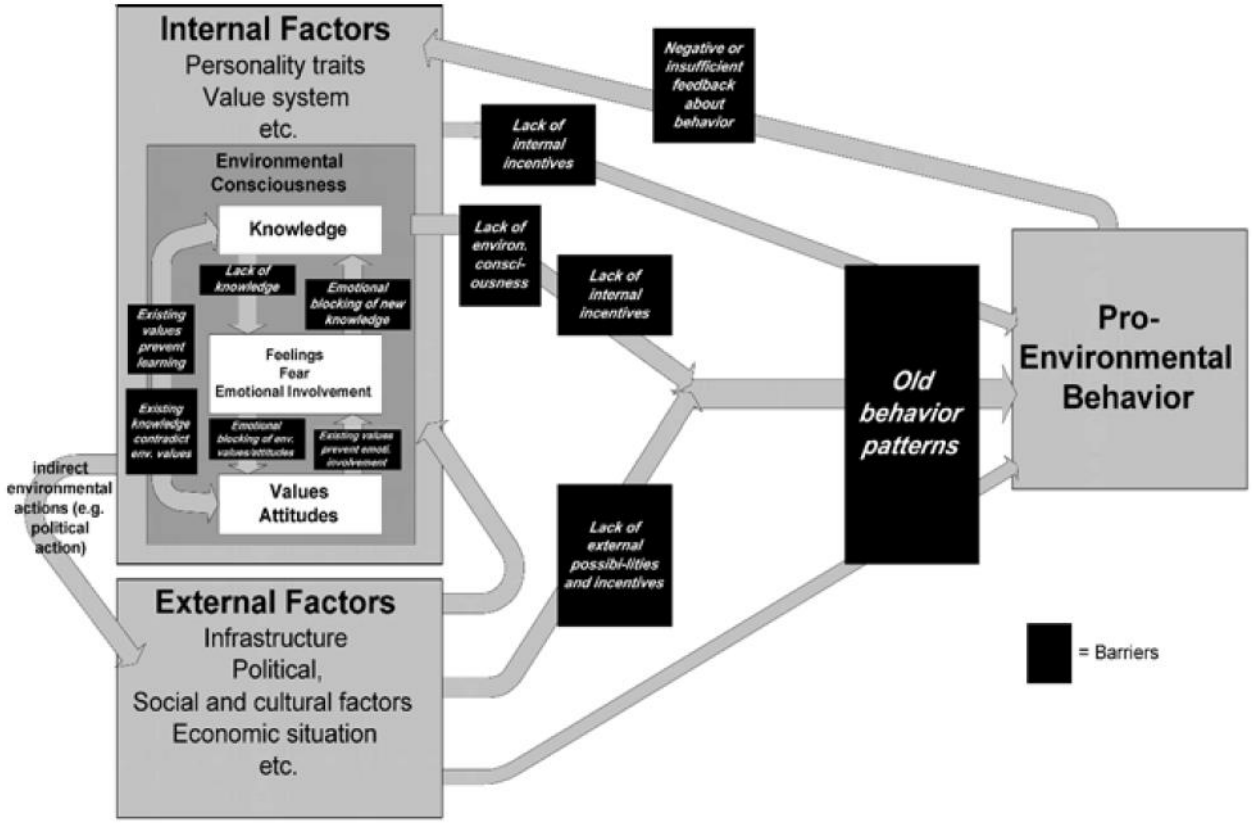


Figure 5: Model of pro-environmental behaviour (Kollmuss & Agyeman, 2002)

2.3 Definition of terms and concepts

2.3.1 Pro-environmental behaviour

For the purposes of this research the term pro-climate behaviour is used in lieu of pro-environmental behaviour. This study is influenced by the definition of Kollmuss and Agyeman (2002, p. 240) in defining pro-environmental behaviour (PEB) as behaviour that "consciously seeks to minimise the negative impact of one's actions on the natural and built world". Examples of PEB might be actively minimising energy or resource consumption, reducing waste production or limiting the use of environmentally degrading chemicals and

materials. However, the concept of PEB can be considered to include pro-environmental actions and behaviours as two different concepts (Jensen, 2002). Following the action-competence approach (Jensen, Schnack, & Simovska, 2000), for an action to occur the person carrying out the action must consciously decide to carry out that action. As Jensen (2002) notes, this is not necessarily the case with behaviour, particularly within the educational setting where behavioural approaches are used to influence or even manipulate pupils into adapting prescribed behaviours (e.g., behaviours that come about through the hidden curriculum). Environmental actions taken can be either direct actions such as setting up composting bins in a school, or indirect actions, such as protesting for change on a Fridays for Future march. Similarly, actions can be either individual or collective and aimed at change in one person's lifestyle in a student's school or at a national level. These are all factors which are considered in the current research's definition of PEB.

2.3.2 Pro-climate behaviour

Conceptually, pro-climate behaviour (PCB) can be incorporated into PEB given that climate is an integral part of the entire environmental system (Wu & Otsuka, 2021, p. 2). For the purposes of this study PCB is defined as personal or collective action related to mitigation or adaptation measures against climate change carried out by second level students. As per the PEB definition, such action can be direct or indirect, but it should target specific climate change behaviours, such as emissions reduction, waste, or dietary changes rather than general environmental behavioural change.

2.3.3 Knowledge

All of the reviewed models of environmental behaviour recognise the role that knowledge plays in PEB. (Stern, 2000; Kollmuss & Agyeman, 2002; Klockner & Blobaum, 2010; Ouellette & Wood, 1998; Kaiser, 2007) While some research considers knowledge as a minor or indirect variable (Ajzen, 1991; Kollmuss & Agyeman, 2002), more recent theories such as the Knowledge Structure Model highlight that there are different types of knowledge

which can have lesser or greater impacts on PEB (Frick, Kaiser, & Wilson, 2004). The current research divides knowledge into the three categories of the Knowledge Structure Model. Following previous research (Bofferding & Kloser, 2015), the current research aims to examine whether particular types of knowledge and knowledge gain, impact PCB more than others.

2.3.4 Climate change education

A number of reviews (Anderson, 2012; Monroe, Plate, Oxarart, Bowers, & Chaves, 2017; UNESCO, 2020) have outlined the aspects of effective climate change education programmes. These aspects include the following principles:

- The CCE was personally relevant and meaningful to learners
- The activities that made up the CCE were designed to engage learners, through experiential, inquiry based or constructivist approaches.
- Activities used approaches that have been found to support the development of critical thinking and scientific inquiry skills in young people (ALLEA, 2020) as well as promoting problem-solving coping skills (Murphy, Smith, & Broderick, 2019; Ojala, 2012).
- The CCE provided an opportunity to practice deliberative discussion.
- The CCE provided an opportunity to interact with scientists and experience the scientific process.
- The CCE provided the opportunity to address misconceptions about climate change.
- The CCE provided the opportunity to use action-based learning to design and implement school or community projects.

2.3.5 Climate change mitigation

This paper used the United Nations definition of climate change mitigation – "a human intervention to reduce the sources of greenhouse gas emissions primarily linked to

human actions of production and consumption" (UNESCO/UNEP, 2011, p. 39). Mitigation strategies can include increasing the use of low or no carbon energy sources, improving energy conservation methods, promoting more climate friendly consumption and lifestyle patterns and reorienting economics, social structures, value systems and ideologies that have resulted in the emission of excessive greenhouse gases (Mochizuki & Bryan, Climate change education in the context of education for sustainable development: Rationale and principles, 2015).

2.3.6 Climate change adaptation

This paper also used the United Nations definition of climate change adaptation – "adjustment in natural or human systems over time to a new and changing environment including anticipatory and reactive adaptation, private and public adaptation and autonomous and planned adaptation" (UNESCO/UNEP, 2011, p. 67). Education plays a large role in adaptation as this dimension involves developing and broadening people's knowledge, skills, and dispositions to better cope with ongoing and future climate change impacts.

2.4 Previous findings and reviews

2.4.1 Factors influencing child and adolescent pro-environmental attitude and behaviours

Previous research (Baierl, Kaiser, & Bogner, 2022; Otto, Evans, Moon, & Kaiser, 2019) suggests that environmental attitude and behaviour can be reliably measured from the age of 7. The same research suggests that children have a maximum pro-environmental attitude and commitment to environmental preservation between the ages of 12-14 which then drops to a minimum at age 16-18 followed by some recovery. Other research suggests a causal link between the development of emotional intelligence and emotional management in adolescents and pro-environmental behaviour (Robinson, Downey, Ford, Lomas, & Stough, 2019). This theory is substantiated by other research highlighting the link between a

biospheric worldview and a stronger internal locus of control among Belgian adolescents (Boeve-de Pauw, Donche, & Van Petegem, 2011).

Schwartz (2012) has clearly demonstrated that pro-environmental behaviours and biospheric values are universally found across all cultures and are easily distinguished from other values, even in adolescence. Further research based on Schwartz's findings highlights how, while pro-environmental values are present, they are at their weakest during middle and late adolescence as they are less prioritised than other values, such as self-enhancement values (Balunde, Perlaviciute, & Truskauskaite-Kuneviciene, 2020; Vechione, et al., 2019; Krettenauer, 2017). While Balunde et al. (2020) consider this is as a result of pro-environmental values and behaviours still being in the process of development, others explain it through the lens of adolescent identity formation and restructuring through contextualised intra and inter-personal processes (Kaplan & Garner, 2017). Whatever the case, research (Crocetti, Rubini, Luyckx, & Meeus, 2007) suggests that young people have already developed a sense of self-identity by early and middle adolescence and that this includes an environmental aspect that is mediated by emotional affinity for nature and sense of morality (Krettenauer, 2017). It also appears that a predominantly egotistical identity, as opposed to biospheric identity acts as a moderator on the number and type of pro-environmental behaviours carried out (Ignell, Davies, & Lundholm, 2019). Some research suggests that it is predominantly the identity of a person, over and above any environmental values or attitudes, that determines the extent to which they carry out pro-environmental activities (Gatersleben, Murtagh, & Abrahamse, 2014). More recent research refines this theory further by suggesting that the extent to which adolescents practice a pro-environmental behaviour or not is not dependent on their self-identified environmental identity; rather it is mediated by how much they actively explore that identity in the environmental domain and actively try out pro-environmental behaviours such as vegetarian food options, recycling and using public

transportation (Kaniušonytė, 2019). This is tied up with research suggesting that a young person's perceived competency at practicing an environmental behaviour has much to do with the likelihood of their carrying out of that behaviour (Roczen, Kaiser, Bogner, & Wilson, 2013).

Several environmental factors that affect child and adolescent PEB's have been identified. Various studies highlight the role that parental actions and communication play in mediating children's pro-environmental behaviours (Jia & Yu, 2021; Grønhøj & Thøgersen, 2012; Grønhøj & Thøgersen, 2009). Studies from both Asia (Jia & Yu, 2021), Europe (Grønhøj & Thøgersen, 2012) and South America (Salazar, Jaime, Leiva, & Gonzalez, 2022) suggest that certain pro-environmental behaviours such as recycling or water use are only marginally mediated by communication between the parent and child about protecting the environment. These studies suggest that certain environmental behaviours such as recycling depend more on authoritative environmental education between the parent and child together with the parents' own behaviour rather than anything a parent might say (Grønhøj & Thøgersen, 2012; Salazar, Jaime, Leiva, & Gonzalez, 2022). More complex actions such as the reuse of material (Matthies, Selge, & Klockner, 2012) or packing a lunchbox with environmentally friendly options (Salazar, Jaime, Leiva, & Gonzalez, 2022) depend on parent-child cooperation, social interaction and communication while even more abstract values are even more difficult to transmit either through parental behaviour or communication (Moore, Wilkie, & Alder, 2001). In terms of communication and PEB amongst adolescents, studies found that discussing climate change with family and friends predicted pro-environmental behaviour as well as increased pro-environmental attitudes (Ojala, 2012; 2012b; Valdez, Peterson, & Stevenson, 2018). Other research suggests that children and adolescents are more likely to follow their parents' indifference or proactive attitude towards climate change and that adolescents who understand the risks of climate

change from communication with their parents are more likely to seek out information by themselves about the topic and to change their behaviour accordingly (Mead, et al., 2012). Finally, it is important to acknowledge the role that climate change education in schools can have on changing parental knowledge. One study showed how parental water use changed significantly after their children had learnt about water conservation in school (Damerell, Howe, & Milner-Gulland, 2013), while a review of other literature (Duvall & Zint, 2007) highlights how children learning about recycling and food waste among other environmental activities can impact parental behaviours in these areas.

A study on the built environment (Tucker & Izadpanahi, 2017) suggests that children attending schools designed for sustainability have attitudes and behaviours that are more pro-environmental than those attending conventionally designed schools. This suggests that we learn from buildings, not just in them (Orr, 1997). Similarly, several studies highlighted the role that being in nature plays when teaching students about nature (Duerden & Witt, 2010; Baierl, Kaiser, & Bogner, 2022; Bogner & Wiseman, 2006; Sellman & Bogner, 2013). Environmental courses that took part in a nature-based setting generally led to better results with regard to increases in pro-environmental attitudes and values when compared to the same courses enacted within a classroom setting. There is also evidence to suggest that time spent in natural settings such as forests also leads to an increase in connectedness to nature (Frankel, Sellmann-Risse, & Basten, 2019) and biospheric values amongst school students (Martin & Czellar, 2017), with both linked to the activation of pro-environmental behaviours. One study (Collado, Staats, & Corraliza, 2013) amongst 10–12-year-olds in Spain suggests that participation in an environmental education course had no effect on children's pro-environmental behaviours; it was only the presence of the course in nature that impacted the willingness of children to carry out environmental behaviours. A later study from the Basque Autonomous Community further substantiated the fact that presence or lack of knowledge

had little impact on PEBs by itself (Agirreazkuenaga & Martinez, 2021). This study suggested the absence or presence of experiential learning about the environment was what mediated the effect on environmental attitudes and behaviours. Finally, other research highlights how facilitating the development of self-efficacy and pro-social behaviours in schools influences pro-environmental values, norms and behaviours as much as environmental education courses (Uitto, Boeve-de pauw, & Saloranta, 2015; Michie, Johnston, Francis, Hardeman, & Eccles, 2008) (See figure 6).

Key Determinants of Behaviour Change from Fishbein et al., 2001; Michie et al., 2004 (see Original Publications for Definitions)

Fishbein, Triandis, Kanfer et al., 2001	*Michie, Johnston, Abraham et al., 2004*
Self-standards	Social/professional role and identity
	Knowledge
Skills	Skills
Self-efficacy	Beliefs about capabilities
Anticipated outcomes/Attitude	Beliefs about consequences
Intention	Motivation and goals
	Memory, attention, and decision processes
Environmental constraints	Environmental context and resources
Norms	Social influences
	Emotion
	Action planning

Figure 6: Determinants of environmental behaviour (Michie et al, 2008)

2.5 Literature search - Method

This paper aimed to conduct a systematic review following the seven stages of Gough's Weight of Evidence Framework (Gough, 2007). This review was conducted in accordance with the PRISMA reporting guidelines for systematic reviews (Moher, Liberati, Tetzlaff, & Altman, 2009). Between July and August 2022, EBSCO Host, Web of Science, Sage and Scopus databases were searched. The search was limited to peer-reviewed articles published in academic journals or book chapters between 1980 and 2023, or from when environmental education first began to be discussed to the point the current research began. The search terms can be found in Table 1 below. A bibliographic search of selected papers relevant to the topic was also conducted, yielding several additional results.

Table 1: Search terms for databases

Participants		Intervention		Outcome
Child* OR Adolescent* OR Youth* OR Teenager* OR Pupil* OR Student* OR Primary school OR Secondary school	AND	Climate change education OR environmental education OR sustainability education	AND	Behavioural changes OR behavioral changes OR environmental behaviour OR environmental behavior OR climate change behaviour OR psychology behaviour OR behavi*

Note: non-English language papers were filtered out at the initial search stage
Searches were limited to between 1980 and 2022
A * after a word signifies that searches for that word can also yield results for variations of the word.

2.6 Study Designs

As this review aims to identify the quantifiable behavioural impacts of climate change education, qualitative research was excluded (see table 2). Other reviews together with opinion-based articles or presentations were also excluded from the review. Following the review process highlighted in Miller et al. (2021), the criteria for the Population-Intervention-Comparator-Outcome (PICO) are outlined below.

Table 2: List of inclusion and exclusion criteria

#	Criteria	Inclusion	Exclusion	Rationale
1	**Participants**	Participants must be children or adolescents between the ages of 11 and 18 attending a primary or post primary school	Any participant who is not between the ages of 3 and 18 and attending a primary school or post-primary school	The review questions are aimed at understanding the effects of a climate change education intervention on children or young people
2	**Study Type**	The study is an experimental or quasi-experimental study by design	The study is a review paper, qualitative research, or not enough information is provided to identify it as an experimental or quasi-experimental research	The review was limited to reviewing quantitative effects of different interventions on climate change behaviour and attitudes.
3	**Setting**	The study occurs in a primary or second level school setting or is part of a school-based programme	The study occurs in a non-school based setting	The review is aimed at understanding school-based or school run climate change education programmes
4	**Intervention**	The intervention being studied is based around climate change or has specific climate change related topics	The intervention is a general environmental education intervention with no specific information concerning climate change	The review seeks to understand the effects of climate change related materials on behaviour specifically related to climate change
5	**Accessibility**	The study was accessible through the internet	The study was unable to be located or accessed through the internet	
6	**Type of publication**	The study was published in a peer-reviewed journal	The study was not published in a peer reviewed journal	The design and methodology of the study has been peer reviewed and can be considered to have a high level of methodological rigour
7	**Language**	The study is published in English	The study is not published in English; only the abstract of the study is published in English	English is the primary language of the author of the review so studies needed to be published in English in order to be understood and reviewed.

2.7 Population

Studies that included primary and secondary school students between the ages of 5 and 18 were included in the review. Studies that considered behavioural change of student teachers based on creating or designing CCE programmes were considered also based on the intervention guidelines highlighted below.

2.8 Intervention

Interventions included in the review were either strictly climate change education or else environmental education, education for sustainable development (ESD) or nature-based programmes that had an explicit climate change element or module to them. General, nature-based interventions, education for sustainability programmes or climate change modules taught as part of other subjects (i.e., science/geography) were not considered for the review. Following Hungerford's critical components on educating for a change in environmental behaviours (1996) and Monroe et al's review (2017) on what constitutes effective CCE, studies were excluded if they did not consist of item one below and one or more of items 2-7:

- Item 1: Climate science overview, taken from IPCC or UNESCO material (IPCC, 2021) (UNESCO, 2019) or adhering closely to IPCC or UNESCO material.

  AND:
- Item 2: Project-based pedagogy which involve student-centred, hands-on learning based on open ended questions, investigation, and student research (Martinez Sainz, Mallon, & Oberman, 2019);
- Item 3: Using deliberative discussion
- Item 4: Opportunities to interact with scientists and experience the scientific process
- Item 5: Opportunities to address misconceptions about climate change
- Item 6: Opportunities to design and implement school or community projects, and/or
- Item 7: Opportunities to use new technology or media formats.

2.9 Comparator

Studies which used comparators were eligible for inclusion if the comparator used was either a control group which consisted of regular classroom learning, a science or geography-based class about climate change or non-climate change focused environmental learning. Studies not using comparators were included if they identified as quasi-experimental studies and identified a clear methodology followed.

2.10 Outcome

While other research has focused on environmental intentions, attitudes and preferences, the current review focuses primarily on behavioural changes related to climate change. This is a change with reference to adaptation or mitigation behaviours within the context of climate change. Such behaviours can include direct individual or family action related to consumption, purchasing, transport, energy, or water usage behaviours. It can also include behaviour related to communicating verbally or otherwise to friends or family about climate change or taking part in public demonstrations to highlight the effects of climate change or encourage the State or industries to act. These changes can be either self-reported, teacher-reported, or changes measured by the researcher of the topic. Other changes, including environmental knowledge, attitudes and values are included in the discussion and write up if there is a link drawn between these changes and behavioural changes.

Study Selection

Search Results were collated into a folder which included the title, abstract and other identifying details of each article (see Figure 7).

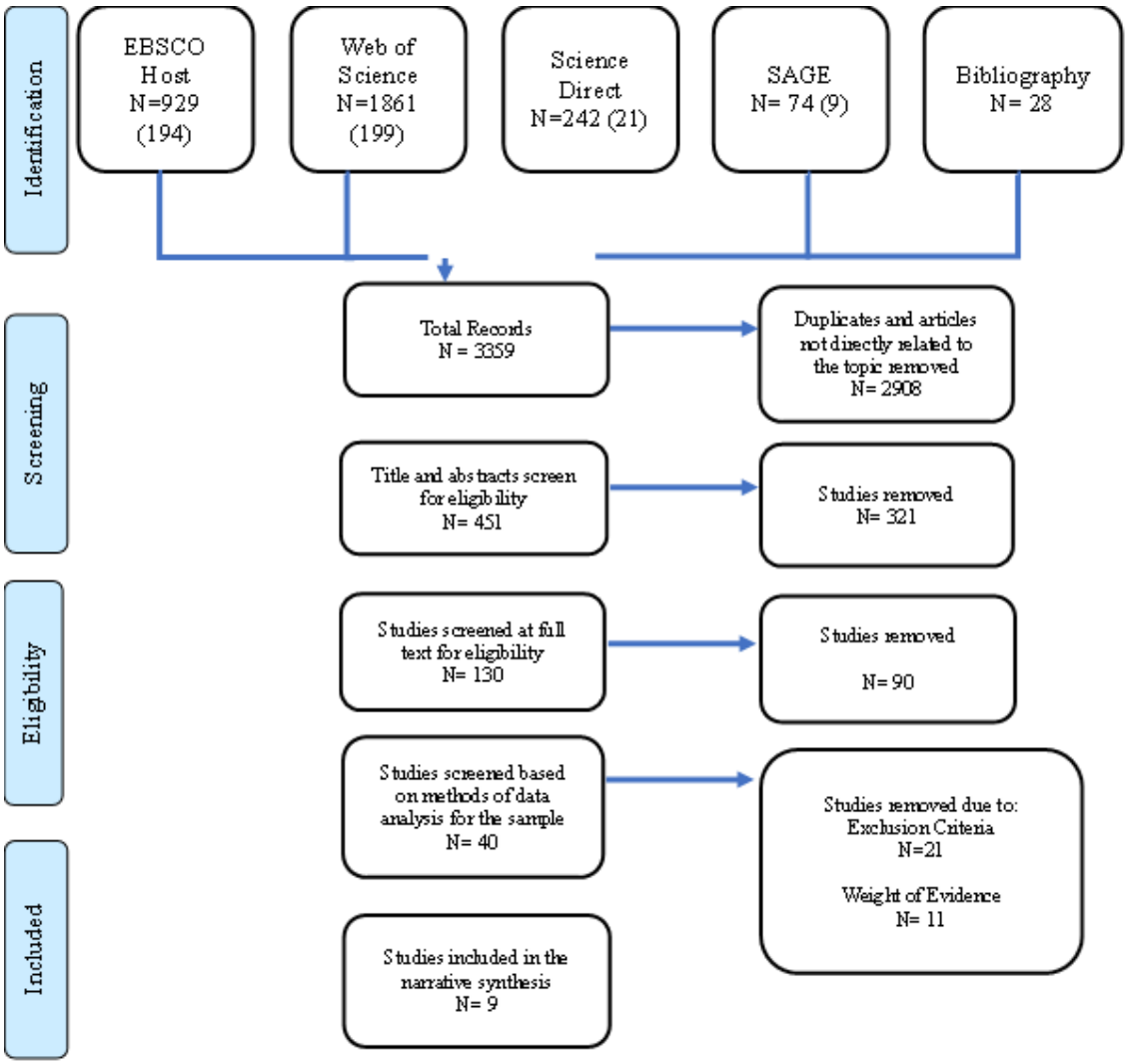


Figure 7: PRISMA flow diagram of the selection process

This folder initially contained 3359 records. The articles were first screened based on title and abstract which led to the elimination of 2908 papers. Screening the remaining papers through a review of the full text led to the removal of a further 99 papers.

The quality of the studies was adjudged through a modified McMaster Critical Review Form for quantitative studies and by following the guidelines for the review form (Law, et al., 1998). Sixty-one studies were included in the methodological review stage and assessed based on criteria including their purpose, design, population sample, intervention, and results (Appendix 1). Following Miller et al's approach (2021), all studies considered in the methodological review stage were assigned a numerical score based on the number of

positive responses received in the McMaster form (Appendix 2). Overall, the quality of the papers was low with the majority of papers scoring less than 7 out of 13. Many of the papers were published in educational journals and didn't follow research methodology which outlined overall design, methodology, sample, or statistical analyses. Of those published in psychological journals, the majority were either mixed method research which didn't outline the quantitative research aspect in enough depth or research papers that did not sufficiently consider the design and methodology. Nine papers received a score of at least 10/13 and were deemed eligible for inclusion in the review.

2.11 Data extraction

Data was taken from each study and input into a table for easy comparison of specific information between the studies under review. This included the type of study, the number of participants, the country the study took place in, the age range of participants, the type of intervention and a description of the behavioural outcomes. This information is contained in Table 3. A brief review of findings from the excluded studies can be found in Appendix 4.

Table 3: Mapping the field: an overview of included studies

	Author and date	Title	Number of participants/ Participant details /Study location	Type	Intervention	Control	Measures	Main Findings
1	(Stevenson, Peterson, & Bondell, 2018)	Developing a model of climate change behaviour among adolescents	*n*=1041 Age range *n*=11-15 USA:30 middle schools	Experimental	4 module climate change education https://research.cnr.ncsu.edu/wwcc/	Yes	Climate change knowledge scale (Stevenson K. , Peterson, Bondell, & et al., 2014) Adolescent climate change hope scale (Stevenson & Peterson, 2015) Climate change concern scale (Stevenson K. , Peterson, Bondell, & et al., 2014) Climate change behaviour scale (Stevenson & Peterson, 2015)	A 4-part climate change intervention led to an increase in knowledge within exp group. There was a weak direct relationship between change in knowledge and change in behaviour. Overall, increased knowledge predicted increased hope and concern which predicted increased levels of climate change mitigation behaviours
2	(Wu & Otsuka, 2021)	Pro-climate behaviour and the influence of learning sources on it in Chinese adolescents	*n* =657 Age range *n* =16-17 China 4 high schools	Correlational	No		Author-developed questionnaire examining relationship between type of CC learning, life experience of CC issues and PCB – quality of measure wasn't discussed	Study found association between learning about CC through school-based CC activity or in museum-based modules and pro-climate behaviour. Learning about CC through social media, mass media, or friends/family didn't impact behaviour.

								Behaviours changed are considered high-cost behaviours that involved time, money or effort
3	(Arya & Maul, 2016)	The building of knowledge, language, and decision-making about climate change science: a cross-national program for secondary students	*n* =141 Age range *n* =13-17 New Zealand China Norway USA	Mixed methods	International student led	No	Pre and post programme interviews coded for knowledge of science language. Experimental dichotomous task involving asking students to throw away paper and recording type of bin thrown into	Statistically significant increase in students understanding climate change as a scientific phenomenon and not a political phenomenon. 27% increase in the propensity of students to recycle
4	(Deisenrieder, Kubisch, Keller, & Stötter, 2020)	Bridging the Action Gap by Democratizing Climate Change Education—The Case of k.i.d.Z.21 in the Context of Fridays for Future	*n* =169 Age range *n* =11-16 Germany Austria 8 secondary schools 1 higher institution	Mixed methods	kidZ21 CCE programme	Yes	Scientifically developed and validated pre and post questionnaires with acceptable Cronbach's alpha scores Students who took part in Fridays for Future and who didn't	Both groups showed increase in self-efficacy, locus of control after intervention. Neither group showed level of immediate concern. Concern was only significant when thinking about 20 years' time. Both groups showed behavioural change in energy consumption, information seeking, waste separation, consumption patterns. Only FFF group showed sig change in diet. Larger overall changes in FFF group

5	(Flora, et al., 2014)	Evaluation of a national high school entertainment education program: The Alliance for Climate Education	*n* =1241 Age range *n* =15-18 USA 49 high schools	Quasi - Experimental	50min entertainment presentation - https://acespace.org/	No	Unvalidated pre and post survey	In the 24 hours after participation significant behavioural change occurred in the following areas: Talking to family/ friends about CC Energy conservation Taking shorter shower Turning off lights and recycling increased but many doing it anyway
6	(Zografakis, Menegaki, & Tsagarakis, 2008)	Effective education for energy efficiency	*n* =321 Age range *n* =6-15 Greece 18 schools	Quasi-exp	Project based learning modules on energy efficiency	No	Unvalidated energy friendly based questionnaire administered at start and end of school year	Both pupils and parents behaved more conscientiously after involvement in the energy education process
7	(Gottlieb et al., 2013)	Encouraging ecological behaviours among students by using the ecological footprint as an educational tool: a quasi-experimental design in a public high	*n* =130 Age range *n* =16-17 Israel 1 school	Quasi-exp	Activities based around learning about the ecological footprint	Yes	A range of validated survey measures including the NEP scale (Dunlap, Van Liere, Mertig, & Jones, 2000) Personal norms (Vining & Ebreo, 1992) Perceived behavioural control (Axelrod & Lehman, 1993) Behavioural intention pro-environmental behaviour (Kaiser, 2007)	There wasn't any effect on the NEP in either group. No change in PBC in either group Significant increase in personal norms in experimental group but not control. Behavioural intention increased for experimental only. No significant behavioural change for experimental group, decline in control group so was difference between them.

		school in the city of Haifa						
8	(Hu & Chen, 2016)	Place-based inter-generational communication on local climate improves adolescents' perceptions and willingness to mitigate climate change	*N*=1168 Age range *n*=10-13 China	Mixed methods	30min lecture, 30 min communication with elders	Yes	Validated survey with high Cronbach's alpha	The exp group showed significant increase in concern, risk perception, perceived behavioural control and mitigation intention. Changes in concern about CC predicted changes in intention. Communication with elders indirectly affected mitigation intention
9	(Nourmoradi, et al., 2021)	The influence of an education program on students' environmental responsibility in developing countries: evidence from Iran	*N*=330 Age range *n=11-15* Iran 2 secondary schools	Experimental	Educational programme 5x 30min sessions over 4 weeks	Yes	Validated questionnaire developed by researcher high reliability on each scale measuring student behaviour, knowledge, and environmental attitude	Several factors affect student knowledge, parental profession and employment status. Attitudes aren't affected by any demographic characteristics. Behaviour is linked to attitude and knowledge and the intervention led to significant increases in all three. Intervention better than control at water conservation, energy conservation, waste management

2.12 Literature review and synthesis of findings

2.13 Participants

Eight of the nine studies met the inclusion criteria of school age students as sole participants. One study (Zografakis, Menegaki, & Tsagarakis, 2008) also considered parents' energy conservation behaviours after their children had participated in an educational intervention as part of their study. Similarly, seven studies involved participants solely from secondary schools with an age range of 11 to 18. One study (Zografakis, Menegaki, & Tsagarakis, 2008) encompassed both primary and secondary school students and had an age range of 6-18. Only one study (Hu & Chen, 2016), which had an age range of 10-13, focused solely on primary schools. In terms of location, all of the educational interventions took place, at least partially, within the primary or secondary school setting.

Seven of the studies took place within a single country context. Two of these were in the USA (Flora, et al., 2014) (Stevenson, Peterson, & Bondell, 2018), two in China (Hu & Chen, 2016) (Wu & Otsuka, 2021), one in Greece (Zografakis, Menegaki, & Tsagarakis, 2008), one in Iran (Nourmoradi, et al., 2021), and one in Israel (Gottlieb, et al., 2013). One study took place in Austria and Southern Germany (Deisenrieder, Kubisch, Keller, & Stötter, 2020) while another study took place in China, New Zealand, Norway and the USA (Arya & Maul, 2016).

Convenience samples were used in four of the nine studies. Three of these samples (Arya & Maul, 2016) (Deisenrieder, Kubisch, Keller, & Stötter, 2020) (Flora, et al., 2014) were based on student populations whose schools had signed up for a climate change education programme. One paper (Gottlieb, et al., 2013) used a small student sample from one secondary school. This paper highlighted the use of a small convenience sample as a limitation to generalising the

results of the study. One study (Zografakis, Menegaki, & Tsagarakis, 2008) explained that it used a representative sample of school-age students. However, no further information is given as to how the sample was chosen. The remaining four studies used random sampling based on picking a selection of schools from a district or region. Five of the studies (Stevenson, Peterson, & Bondell, 2018; Deisenrieder, Kubisch, Keller, & Stötter, 2020; Gottlieb, et al., 2013; Hu & Chen, 2016; Nourmoradi, et al., 2021) used controls and in each of these studies students were randomly allocated to the control or experimental criteria. A total of 5,198 participants took part in the nine studies. The number of participants included in the analysis of each study ranged from 130 in the Gottlieb et al (2013) study to 1241 in the Flora et al. (2014) study. The mean number of participants for the study is 578 however four of the studies included over 1000 participants in their sample. One study (Gottlieb et al, 2013) took place in one school only while the two USA-based studies took place in 30 (Stevenson, Peterson, & Bondell, 2018) and 49 schools (Flora, et al., 2014) respectively.

Attrition rates were controlled for in some studies, for instance Stevenson's (2018) study aimed for a response rate of 25% in the schools they communicated with and an attrition rate of 20% of participating teachers. This study failed to mention the attrition rate of participants, however. Within the Chinese studies, an attrition rate of less than 1% was documented in Wu et al's paper (2020) and 4.9% in Hu et al's research (2016). The Austro-German study (Deisenrieder, et al., 2020) recorded an attrition rate of 9.6%. The highest attrition rate was from one of the large-scale USA studies which used a randomised sample. Of 2,847 surveys administered at the pre stage, only 1,241 matched post intervention surveys could be used. This was explained as being due to surveys being handed out to all participants who took part in the intervention. It may also be suggestive of a risk to the external validity of the study. Another

attrition rate recorded as high was in Arya et al's multinational study (2016). As the teachers in one country couldn't complete the final part of the research, the dropout rate was documented as 32%. The studies from Greece (Zografakis, Menegaki, & Tsagarakis, 2008), Iran (Nourmoradi, et al., 2021), and Israel (Gottlieb, et al., 2013) do not mention attrition or dropout rates. There are also discrepancies between the total number of participants in the study and the total number in the control and experimental groups for Gottlieb et al's study (2013), affecting the overall reliability and validity of the research.

2.14 Measures

Eight of the nine papers relied on the measurement of self-reported climate change mitigation or adaptation related behaviours. One study (Arya & Maul, 2016) used interviews as well as a quasi-experimental methodology that involved asking students to throw paper away and to document the type of bin (waste/recycling) the paper was put in. There was a large variance in the quality and type of instruments used by the eight studies using instruments. Two studies (Stevenson et al., 2018; Gottlieb et al., 2013) used empirically researched, peer-reviewed instruments for all measurements. Two of the authors of one of these studies (Stevenson and Peterson) are relatively prolific in their work on environmental and climate change related behaviour and were able to use instruments that they had developed themselves to measure knowledge, hope, concern, and behaviour related to climate change. Gottlieb et al's study (2013) also made use of a range of peer-reviewed instruments to measure biospheric values (Dunlap, Van Liere, Mertig, & Jones, 2000), perceived environmental behavioural control (Vining & Ebreo, 1992), and pro-environmental behaviour (Kaiser, 2007). A further three studies utilised instruments that the researcher had validated for reliability based on internationally acknowledged Cronbach's Alpha scores (Hu & Chen, 2016) (Nourmoradi, et al., 2021)

(Deisenrieder, Kubisch, Keller, & Stötter, 2020). These studies all included measures related to climate change knowledge, perceptions of climate change, related behavioural intentions, and self-reported behaviours. One of these studies also included questions related to climate change concern (Deisenrieder, Kubisch, Keller, & Stötter, 2020). Three other studies were based on questionnaires that the researcher had put together themselves and which didn't include evidence of validation or acceptable reliability (Flora, et al., 2014) (Zografakis, Menegaki, & Tsagarakis, 2008) (Wu & Otsuka, 2021). One of these solely measured self-reported behaviours relating to energy conservation measures (Zografakis, Menegaki, & Tsagarakis, 2008). The two others measured a range of behaviours including energy and water conservation and communicating about climate change to friends and family. Interestingly, Wu and Otsuka's paper was the only one that divided climate change behaviours into high-cost behaviours that involved a significant investment of time, money, or effort, such as changing one's diet and low-cost, easy to enact behaviours such as liking a climate change initiative on social media.

In terms of topics covered, five of the nine papers (Stevenson, Peterson, & Bondell, 2018) (Wu & Otsuka, 2021) (Deisenrieder, Kubisch, Keller, & Stötter, 2020) (Flora, et al., 2014) (Zografakis, Menegaki, & Tsagarakis, 2008) focused specifically on understanding behavioural change related to particular climate change adaptation or mitigation measures. One paper (Hu & Chen, 2016) looked more generally at willingness to introduce behavioural changes related to climate change mitigation. Another paper (Deisenrieder, Kubisch, Keller, & Stötter, 2020) focused on knowledge and attitudinal changes and how they relate to an experimental recycling task. The final two papers related to environmental (water and energy conservation) (Nourmoradi, et al., 2021) or ecological (changing ecological footprint) (Gottlieb, et al., 2013) behavioural changes that had a direct overlap with climate change mitigation behaviours.

2.15 Interventions

The type of intervention used in the different papers was a particularly varied aspect of this systematic review (see table 4). Two papers (Deisenrieder, Kubisch, Keller, & Stötter, 2020) (Stevenson, Peterson, & Bondell, 2018) had the full intervention outline available through an easily searchable programme name or website highlighted in the text. These two papers also linked their interventions to environmental or climate change related behavioural models. These two programmes were the only two to include all of the features that make up a gold-standard climate change programme either. One other programme had further information about the intervention available online but the intervention itself wasn't readily accessible. Some of the remaining papers (Zografakis, Menegaki, & Tsagarakis, 2008; Gottlieb, et al., 2013) had detailed descriptions of the programme that they used within the papers, while others had shorter outlines of the interventions (Nourmoradi, et al., 2021; Arya & Maul, 2016). One paper also considered the behavioural effects of different intervention types (Wu & Otsuka, 2021).

In terms of intervention features, the most common aspect, included in all of the interventions, was the presence of an overview of the climate science along with deliberative discussion amongst students. Working with a climate scientist or other expert featured in all of the papers also save one (Hu & Chen, 2016). In terms of interactions with others outside of the school faculty, two interventions involved members of the community. In the case of Deisenrieder et al's paper (2020), this involved specialists located in an alpine region who worked in the area of tourism, glacier monitoring and soil analysis. Hu & Chen's intervention (2016) involved classes meeting directly with elderly members of their community to hear about the climate change that they had experienced during their own lifetime. All of the interventions except for one were particularly student-centred and involved students working in groups and

individually to complete projects related to climate change. The one intervention that wasn't consisted of a passive learning, "education-entertainment" intervention format (Flora, et al., 2014).

The duration of the interventions also varied, ranging from a one-hour explainer (Flora, et al., 2014) to weekly activities over the course of a year (Zografakis, Menegaki, & Tsagarakis, 2008). Many of the interventions consisted of a series of programmes, generally once a week, over the course of 4 to 6 weeks (Nourmoradi, et al., 2021) (Gottlieb, et al., 2013) (Deisenrieder, Kubisch, Keller, & Stötter, 2020) (Arya & Maul, 2016) (Stevenson, Peterson, & Bondell, 2018). These interventions were generally classroom based, although one (Deisenrieder, Kubisch, Keller, & Stötter, 2020) contained outdoor learning to improve learning on the local Alpine setting.

2.16 Literature review findings

Six of the nine studies reported that undertaking climate change education interventions had a significant and predictive positive effect on behaviours or behavioural intentions related to climate change mitigation and adaptation. Two of the outlying studies (Gottlieb, et al., 2013; Stevenson, Peterson, & Bondell, 2018) found statistically significant increases in knowledge, behavioural intentions, environmental norms, and environmental behaviour control but that these didn't translate into a significant increase in or causal link with pro-environmental or climate change related behaviour. One other study (Hu & Chen, 2016) noted an indirect link between intention to mitigate climate change and the intervention.

Table 4: Features of the different interventions described in papers.

Paper Author	(Stevenson, Peterson, & Bondell, 2018)	(Wu & Otsuka, 2021)	(Arya & Maul, 2016)	(Deisenrieder, Kubisch, Keller, & Stötter, 2020)	(Flora, et al., 2014)	(Zografakis, Menegaki, & Tsagarakis, 2008)	(Gottlieb, et al., 2013)	(Hu & Chen, 2016)	(Nourmoradi, et al., 2021)
Link to intervention	Yes	No	No	Yes **	No***	No	No	No	No
Climate science overview	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes
Project-based	Yes	Yes*	Yes	Yes	No	Yes	Yes	Yes	No
Student centred/ hands on	Yes	Yes*	Yes	Yes	No	Yes	Yes	Yes	No
Uses Student research	Yes	Yes*	Yes	Yes	No	Yes	Yes	Yes	Yes
Outdoor/ nature-based element	Yes	No	No	Yes	No	Yes	No	Yes	No
Deliberative discussion	Yes	n/a	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Interaction with scientists/scientific process	Yes	Yes*	Yes	Yes	Yes	Yes	Yes	No	Yes
Addressed misconceptions about climate change	Yes	Yes	yes	n/a	Yes	No	No	Yes	Yes
Uses community members	Yes	No	No	Yes	No	No	No	Yes	No

* - partly, generally for one experimental group but not all groups
** - link for programme not given on paper but programme easily found using the Duckduckgo search engine
*** link not given but further information about programme found on programme website

In terms of models of environmental behaviour change, four of the papers (Stevenson, Peterson, & Bondell, 2018; Nourmoradi, et al., 2021; Hu & Chen, 2016; Gottlieb, et al., 2013) directly link their findings on behavioural change with other model variables (Kollmuss & Agyeman, 2002). In the case of the Iranian paper an increase in environmental behaviour was not only linked with attitude or behaviour. Several other variables including student age, parental income and educational attainment were all found to positively, but indirectly, relate to an increase in behaviour. This finding was also mentioned in Deisenrieder et al's paper (2020) and Stevenson et al (2018). The latter paper highlighted the link between increased individual and collective action on climate change in schools that are within areas of higher socio-economic status. While they suggest that this might be related to schools based in lower socio-economic areas trying to focus more on basic literacy and numeracy, further research is needed to uncover why exactly this occurs.

Stevenson et al (2018) use the findings from their experimental study to validate a new climate change related behavioural model (see figure 8). This model suggests that the provision of education related to climate change leads to an increase in knowledge related to climate change. An increase in knowledge, in turn, predicts increased levels of hope and concern related to climate change. An increase in these two factors together predicts an increase in climate change related behaviours. This important finding suggests that, while climate change knowledge isn't a direct predictor of behaviour, its absence leads to students having more polarised views, a lack of hope, and less concern about climate change as an existential issue.

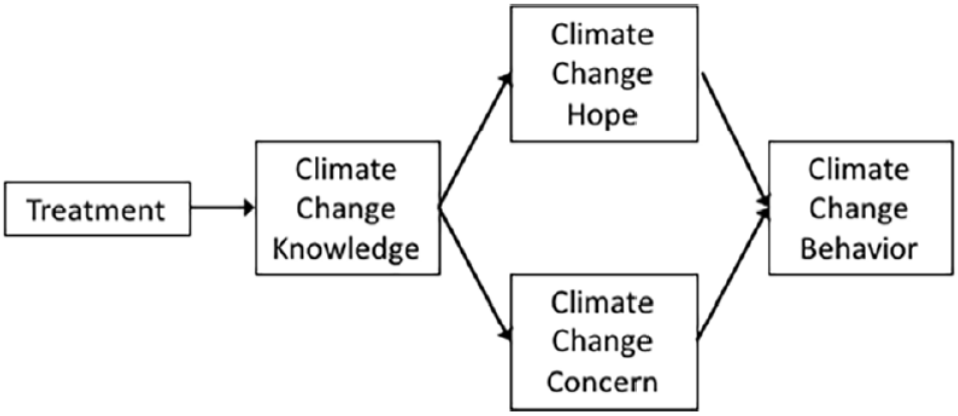


Figure 8: Stevenson, Peterson & Bondell's (2018) model of adolescent climate change behaviour

Several of the studies focused on the types of climate change related mitigation or adaptation behaviours that were changed. Table 5 outlines the variety of behaviours highlighted by different studies. In some cases, (Gottlieb, et al., 2013; Nourmoradi, et al., 2021) these behaviours were included based solely on one item in a self-reported behavioural instrument. The remaining papers went into more details to identify and explain these behaviours, either through the experimental process itself (Arya & Maul, 2016; Zografakis, Menegaki, & Tsagarakis, 2008; Flora, et al., 2014) or through the write-up (Wu & Otsuka, 2021; Deisenrieder, Kubisch, Keller, & Stötter, 2020; Stevenson, Peterson, & Bondell, 2018). Overall, four behaviours were mentioned in six papers. These were water conservation, energy savings, communication related to climate change, and increased knowledge seeking/ awareness/understanding of the issue. Water conservation and energy saving, together with recycling, which were mentioned by five papers, can generally be considered low-cost examples of climate change behaviours and easy to implement both at home and school. Only one paper considered actual behaviour, as opposed to self-reported levels of conservation behaviour and actual behaviour. None of the studies compared self-reported levels of behaviour to actual

behaviour either, a relationship which is known to have low correlations in environmental terms (Corral-Verdugo, 1997).

Table 5: Types of behaviours included in papers from most to least commonly mentioned

Behaviour type	**Number of studies**	**Papers that include behaviour***
Water conservation	6	1,2,3,4,5,6
Energy saving	6	1,2,3,4,5,6
Communication behaviours related to CC	6	1,2,3,4,7,8
Increased understanding of climate change/ environmental issues or increased knowledge seeking behaviours associated with CC	6	1,2,3,7,8,9
Recycle more things at home/ in school	5	1,2,3,4,6
Increased use of bicycle/ public transport	4	1,2,3,5
Increased environmental activities/ climate change mitigation/ adaptation activities	4	2,3,7,8
Buy/ use less over packaged/ plastic goods	4	2,3,4,7
Use less disposable/ fast moving consumer goods	3	2,3,7
Decrease food waste	2	2,3
Change diet	2	2,3
Buy/use second hand/ shared goods	1	2
Buy/use local/ eco-label goods	1	2

1= (Stevenson, Peterson, & Bondell, 2018)
2= (Wu & Otsuka, 2021)
3= (Deisenrieder, Kubisch, Keller, & Stötter, 2020)
4= (Flora, et al., 2014)
5= (Zografakis, Menegaki, & Tsagarakis, 2008)
6= (Nourmoradi, et al., 2021)
7= (Gottlieb, et al., 2013)
8= (Hu & Chen, 2016)
9= (Arya & Maul, 2016)

Wu & Otsuka's study (2021) considered how different spheres of learning might predict or impact on different types of high or low-cost climate related behaviours. This study determined that learning about climate change through a school-based curriculum, student-centred activities or science museum-based activity days could positively predict an increase in pro-climate behaviour. On the other hand, learning about climate change through social media, mass media or through conversations with friends or family had no impact on behaviour, positive or negative even though it was through these sources that most students said that they got the majority of their information. Wu and Otsuka's paper (2021) was the only paper to consider pro-climate behaviours that take place primarily due to environmental considerations versus incidental pro-climate behaviours that take place as a secondary effect of money saving or convenience. This paper found that climate change education predicted positive increases in high-cost behaviours requiring time, money, or effort such as buying or using local or eco-goods, participating in environmental activities, and participating in environmental legal systems. The study also found that other behaviours generally considered pro-climate change or pro-environmental, such as taking shorter showers, reducing food and energy waste, using public transport, and purchasing less disposable or single use commodities were more motivated by money saving or convenience factors as opposed to environmental reasons. Interestingly, in this Chinese study, some behaviours including eating less meat and walking or cycling were more related to health orientation; their environmental benefits were only a secondary factor. On the other hand, the joint Austro-German study (Deisenrieder, Kubisch, Keller, & Stötter, 2020) suggested an indirect causal link between the provision of a climate change intervention, attending Fridays for Future activist events and making dietary changes for environmental reasons.

Five of the papers (Wu & Otsuka, 2021) (Nourmoradi, et al., 2021) (Deisenrieder, Kubisch, Keller, & Stötter, 2020) (Zografakis, Menegaki, & Tsagarakis, 2008) (Gottlieb, et al., 2013) discussed non-environmental rationale for taking climate action. All of these papers mentioned the economic cost of behavioural change as a factor that may influence students' environmental motivations. Only one of these papers (Wu & Otsuka, 2021) actually factored in a money saving or economic rationale into their explanation for behavioural changes and attempted to differentiate between climate change actions taken for economic reasons and actions taken solely for environmental reasons. Gottlieb's paper (2013) did highlight the role that other situational factors such as economic constraints, social pressures and availability of sustainable resources or facilities might play in reducing the motivation of a student to enact a particular behaviour.

Two of the papers report findings related to patterns of affective learning. Stevenson et al's paper (2018) specifically aimed to address hope and concern within the intervention. This research found that the science teaching through which the intervention was presented focused more on the cognitive aspect of learning, rather than affective which led to an increase in climate change knowledge without a proportional increase in climate change behaviour. Wu & Otsuko's paper (2021) also highlighted the importance of the affective dimension in activating new climate change related behaviours. They mention how active learning methods, e.g., activity based, experiential and action-based learning all positively impact the cognitive and affective effects of climate change education. This in turn changes the perception of a behaviour cost for students which leads to pro-climate behaviour. Arya and Maul's paper (2016) also highlights the role that different learning methods might play in the adaption of climate change related behaviours. They note that students will more actively engage with the science behind the topic

of climate change if given data aimed at their age group and if afforded the time and space to explore such data with their classmates. They also note how this process moves climate change discussions amongst students away from ideological and towards science-based perspectives and evaluating the role that their own lifestyles play in this. Another aspect of this is reflected in Hu and Chen's paper (2016) which also noted how communicating through organised, structured focus groups with village elders who had experienced climate change themselves throughout their lives led to less uncertainty about climate change and an increase in intention to mitigate against climate change by study participants.

The role that students can play as agents of change amongst their school peers, at home, and within their wider communities is mentioned in the findings of 5 of the 9 papers. This is important given the need to move from individual to collective action and the fact that most people will only take collective action if they witness others doing the same, as Stevenson et al (2018) mention in their paper. Some of the papers (Wu & Otsuka, 2021; Arya & Maul, 2016; Zografakis, Menegaki, & Tsagarakis, 2008; Nourmoradi, et al., 2021) consider how the use of the classroom as a safe space to discuss climate change allows both specialists and students with knowledge about the topic to act as agents of change. This has the additional benefit of discussing the social and behavioural aspects leading to climate change as opposed to a simplistic focus on the identification of particular gases as the reason for climate change. This was substantiated by Arya & Maul (2016) who noted how student-centred and student-led learning about climate change promoted deeper understanding and affect in relation to the topic in a classroom context. Another paper (Gottlieb, et al., 2013) highlighted how a particular intervention method, the creation of a school level ecological footprint allowed students to better understand the impact of their lifestyles at familial, school, state, and global levels. Zografakis et

al's research (2008) also noted how students who had been 'converted' to rational energy use and conservation attempt in turn to 'convert' their family, relatives, friends, and neighbours. Other research (Deisenrieder, Kubisch, Keller, & Stötter, 2020) emphasised the multiplicative role that climate change education can have as it leads students who are already participating in the Friday for Futures movement to encourage peers from their class to engage with the movement as well. Research on the effects of a brief intervention noted how students who had participated in a one hour talk on climate change were more likely to attempt to explain the topic to others and to establish a conservation project in their school than children who hadn't (Flora, et al., 2014). Despite this, some papers (Wu & Otsuka, 2021) described the ineffective nature of learning about climate change informally from peers when compared to learning about it through formal programmes or from experts.

One of the more interesting findings from the study references the ongoing debate as to what extent individuals should feel responsible for climate change and should attempt to change their behaviour when multinational corporations and state-owned fossil fuel companies produce about 70% of global emissions (Hyman, 2020; Tallulah, 2018). Gottlieb et al's paper (2013) explained how students were made to feel personally responsible for the extent of climate change and that a perceived connection between personal behaviours and the natural environment should be established in order to promote a strong moral commitment which in turn is needed for behavioural change. This research used ecological footprint calculators as appropriate starting points for encouraging personal responsibility. It should be noted that this paper didn't find causality between any environmental behaviours and the intervention, however. Other papers note that, in terms of climate change education, learning about the difference between acting on climate change versus feeling personally responsible for climate change is not just semantic and

is an integral part of promoting hope for the future (Stevenson, Peterson, & Bondell, 2018; Deisenrieder, Kubisch, Keller, & Stötter, 2020). Hu & Chen's paper (2016) also emphasised how meetings with local elder witnesses of climate change allowed participants to start feeling that climate change was both personally relevant to them as well as a cause for concern that they should act on. This and other papers (Gottlieb, et al., 2013; Deisenrieder, Kubisch, Keller, & Stötter, 2020; Stevenson, Peterson, & Bondell, 2018) note the importance of reducing the psychological distance between the effects of climate change and individuals, both through effective communication and also through place-based interventions. One paper (Deisenrieder, Kubisch, Keller, & Stötter, 2020) noted that trips to a local alpine area affected by climate change did not have the required effect of reducing the psychological distance and increasing the sense of immediacy of climate change. Adolescents continued to find it difficult to understand that climate change was having an impact on their lives.

2.17 Conclusion

While the concept of effective environmental or CCE strategies has been discussed previously in other reviews (Hungerford & Volk, 1990; Monroe, Plate, Oxarart, Bowers, & Chaves, 2017; Somerwill & Wehn, 2022) this review identifies five factors associated with behavioural change linked to climate (PCB).

2.17.1 NEP and PCBs

Other environmental research has highlighted the link between the provision of nature-based environmental learning and stronger responses on the New Environmental Paradigm (NEP) scale, a measure of environmental concern about how biospherically oriented a person is (Dunlap, 2008; Johnson & Činčera, 2021; Bernstein & Szuster, 2019). This in turn can be linked to an ecological outlook and the presence of increased pro-environmental behaviours (Dunlap,

Van Liere, Mertig, & Jones, 2000). Research aimed at understanding whether classroom and nature-based education programmes leads to differences in NEP scores remains to be explored. Similarly, understanding whether a person's environmental outlook as determined by the NEP scale is associated with individual, collective, direct, and indirect PCBs in the same way as it is with general environmental behaviours might usefully be considered in later research.

2.17.2 What lies between knowing and doing

Many papers noted an indirect causal link between the provision of climate change education, knowledge gain and PCB, as per Kollmuss & Agyeman's (2002) model of environmental behaviour. Climate change is a particularly complex topic to teach within the ambit of environmental studies. Not only is it multi-disciplinary in nature, its ubiquitous and often times emotive presence in the news cycles mean that many children and their families have an opinion on the extent and possible solutions to it. All of the papers in this study highlighted the important role that discussion amongst peers and student-centred learning played in moving the conversation about climate change away from ideological perspectives and towards science and practical solutions. As is well known, an increase in knowledge and understanding about climate change doesn't necessarily lead to action or increased behaviours (Dunlap, Van Liere, Mertig, & Jones, 2000) (Lunholm, 2019) and it would be erroneous of a researcher to simplify the complexity of climate change related behavioural change solely to the provision of knowledge by itself. Consequently, the papers in this study were considered from the perspective of what they bring to the table other than knowledge gain, and how they go about it.

All of the interventions reviewed in this paper relied primarily on classroom-based methodologies. This occurs despite the broad variety of methodologies identified in literature reviews of environmental education and the often times better results demonstrated from non-classroom based learning about nature or environmental topics when compared to outdoor based

programmes (Johnson & Činčera, 2021) (Monroe, Plate, Oxarart, Bowers, & Chaves, 2017) (Boyes & Stanisstreet, 2011) (van de Wetering, Leijten, Spitzer, & Thomaes, 2022). Two of the papers used a particular place-based methodology with the aim of removing the psychological distance between participants and climate change. Despite this, neither of these papers reported a direct causal link between holding the intervention in an area affected by climate change and any behavioural change. Similar to other studies (Khadka, Lie, Stanis, & Morgan, 2021) they did highlight how participants taking part in place-based learning carried out by specialists that leads to an affective reaction are more willing to support climate change mitigation measures or make personal changes to their own lifestyles.

The role of 'non-teachers' in providing climate change education also needs to be considered. While teachers played a principal role in the provision of CCE for several of the interventions, all of the interventions were either delivered or co-facilitated by community members, scientists, climate specialists, trained students, or the researchers themselves. While some of the programmes mentioned involved clearly delineated roles and scripts to deliver (Flora, et al., 2014), the diverse roles that facilitators played and the differences in how different classrooms received them is a variable that hasn't been widely discussed in terms of CCE yet. Similarly, children are both being provided with messages (Jennings, 2019) and seeking information about climate change from a number of different media and educational sources (Mead, et al., 2012) at a given time. Wu & Otsuka's paper (2021) builds on other informational models about climate change (Kahlor, 2007) to identify the effectiveness of different sources that people receive information about climate change from the most effective (schools and museums) to the least effective (social media, mass media, family and friends). This paper also notes how those sources can have a different impact on PCB's, suggesting a role for formal or specialist

educational models in the provision of CCEs. The multiplicative role of students encouraging family members and other students to act in a pro-environmental manner was also covered by several papers (Hu & Chen, 2016) (Deisenrieder, Kubisch, Keller, & Stötter, 2020) (Wu & Otsuka, 2021) and explicitly tailoring climate change education to increase multiplicative actions should also be considered in the development of climate change education modules, given that we know students are more inclined to seek information and take action on a topic if they perceive the risk from a topic as important enough to cause worry to their social milieu (Kahlor, 2007).

The issue of *who* is delivering the programme is compounded by the question of *how* they are delivering it. Several papers mentioned new or novel methodologies, from 'edutainment' (Flora, et al., 2014) to action learning (Wu & Otsuka, 2021) to group based research (Gottlieb, et al., 2013). All of the different methodologies reported knowledge gains attributable to the particular type of programme that was being used. As outlined in the findings, some papers also explored socio-economic, gender based and cultural factors for the differences in success between schools or regions. Interestingly the programmes that were tailored towards inculcating children with an understanding of climate change to their specific region had mixed results in increasing understanding or behaviour (Hu & Chen, 2016; Deisenrieder, Kubisch, Keller, & Stötter, 2020).

2.17.3 How do you feel about climate change?

While one paper made explicit mention of the affective quality of the material that students were being exposed to (Stevenson, Peterson, & Bondell, 2018), the other papers thought it enough to mention the fact that students were able to discuss climate change with their peers from a scientific point of view. There is clear evidence highlighting the emotive nature of climate change (Ojala, 2005; Ojala, 2012; Hungerford & Volk, 1990) and that children will respond to

material related to climate changes using different patterns of coping, depending on how the material is presented to them and by whom (Ojala, 2012) . Even the paper that mentioned the importance of a sense of both hope and concern about climate change (Stevenson, Peterson, & Bondell, 2018) didn't mention strategies that teachers were provided with to engender the most child and climate friendly responses to the climate change material.

2.17.4 Are all behaviours the same?

The manner in which behaviour is treated by the different papers in this review was by far the most complex. None of the papers gave a justification for how they chose behaviours and only some (Stevenson, Peterson, & Bondell, 2018; Hu & Chen, 2016; Deisenrieder, Kubisch, Keller, & Stötter, 2020; Wu & Otsuka, 2021) even mentioned the fact that they were choosing self-reported behaviours as a limitation to their study. While some provided a definition of what a PCB (Stevenson, Peterson, & Bondell, 2018) or ecological behaviour (Gottlieb, et al., 2013) was, there were no definitions or categorisation of the different types of behaviours. The work undertaken by Wu & Otsuka to define different types of methodologies, attitudes, and behaviours shines a light on the developments still to be made in this area. This Chinese study identified high and low-cost behaviours and was able to ascribe different motivations for increases in the different behaviours. For example, while all of the other studies detailed energy saving as a purely environmental behaviour this study identified Chinese students as engaging in energy saving activities primarily for economic rather than environmental reasons. There were many other behaviours known to have an environmental impact, but which were identified in this study as being carried out for other reasons such as health (eating less red meat), fitness (walking) or economic (turning off lights).

Several papers (Stevenson, Peterson, & Bondell, 2018; Hu & Chen, 2016) mentioned the ideological battleground taking place around climate change, with one paper even stating its

research intention partly as the movement of the discussion of climate change in schools more towards a scientific perspective and away from ideological explanations (Deisenrieder, Kubisch, Keller, & Stötter, 2020). Despite this, few of the papers actually explained the different roles that individual and collective actions might play with regard to climate change mitigation and adaptation, or the need to focus on one type of action above the other. This is important to consider in light of greenhouse gas (GHG) producing companies providing funding towards research perspectives that focus on individual responsibility rather than any form of collective responsibility. Similar to the aims of environmental education (Boyes & Stanisstreet, 2011), stakeholders acting collectively to put pressure on states to better focus on climate change policies and holding GHG producing companies accountable (Hyman, 2020; Griffin, Heede, & van Der Vlugt, 2017) should be an integral part of any behaviours considered within the context of climate change education. Deisenrieder et al's research (2020) on the link between the Fridays for Future movement and mainstream climate change education in secondary schools provides an interesting starting point for this. Any such research should also consider, not only individual and collective actions, but also direct and indirect actions taken to mitigate against climate change. Direct actions are those that you take in your own life such as using public transport more frequently whereas indirect actions might consist of emailing a politician requesting that they enact a climate policy. As researchers point out (Somerwill & Wehn, 2022; Boyes & Stanisstreet, 2011) with regard to general environmental behavioural research, differentiating between these behaviours in climate change research will involve understanding self-efficacy levels, or personal behaviour control levels that students feel each action requires.

As mentioned in the findings section, several of the papers started their theoretical observations at knowledge gain and moved either directly or indirectly towards pro-

environmental behaviours, as per the dominant theory of environmental behavioural change. While collective behavioural change was discussed in some of the included papers, research findings generally focused solely on individual behavioural change. There are, undoubtedly difficulties in generating accurate data on the effects of CCE programmes at family and community levels however this is an important research direction to consider at this point in time. Similarly, it is important to establish criteria that determines whether a behaviour that has an environmental impact has been undertaken specifically for environmental reasons or for other reasons. Research also needs to start comparing the setting in which climate change education takes place and whether certain settings are more conducive to climate change related behaviours than others.

2.17.5 Recommendations for CCE interventions

In line with UNESCO's gold standard recommendations for CCE together with the findings from this review the following recommendations for future climate change education interventions can be made:

- It is important to consider the duration of the CCE intervention. While one study measured a significant knowledge change after a brief, one hour intervention, all other studies needed a minimum of 8 hours or 12 40-minute periods to be able to measure significant behavioural change in relation to PCBs
- Currently, many CCE modules in the secondary curricula are narrowly focused on the systems strand of knowledge, for instance learning about the greenhouse effect isolated from socio-economic causes for worldwide changes in the greenhouse effect. This occurs despite the systems level of knowledge having little effect on PCBs (Bofferding & Kloser, 2015). Students should be exposed to information over all three levels of the

knowledge structure model (Frick, Kaiser, & Wilson, 2004)/ UNESCO climate change education model (UNESCO, 2010). In practice this means designing interventions that includes describing the types of actions that can influence climate change on individual, family, community wide and larger scale levels. It also means including material that encourages students to consider what sort of actions or behaviours will lead to the greatest environmental benefit when taken.

- Ideally, any intervention will be as student centred and involve as much interaction between students as possible. The facilitator should be there to use their expert knowledge to encourage students to reach different learning goals set for each module rather than falling back on explaining climate change to them.
- It is difficult to surmount the limitations that self-reported behavioural questionnaires pose. Despite these limitations, research generally use them as a quantitative and convenient method for measuring change in behaviour over time. It is recommended that other, non-formal measures such as requesting students to draw posters or write letters related to climate change behaviours be used in conjunction with self-reported behavioural instruments. Such other measures should allow an extra level of detail in describing results while also allowing researchers to identify the different levels of the knowledge structure model that students have absorbed.
- The CCE should be clear in identifying and linking behaviours that can be taken at the individual, family, school, local community, and national levels. A truly successful programme should empower the students to understand the need to act over different levels while leaving them with the skills and competencies to do so.

3 Empirical Paper

3.1 Introduction

Globally, a large majority of young people consider climate change as an emergency requiring much wider reaching environmental policies and actions than states currently practice (UNDP and University of Oxford, 2021). These attitudes reflect the growing public conversation around climate change that can be seen in schools through the Irish Schools Sustainability Network (Kirwan, 2021), on the streets through the Fridays for Future movement (Deisenrieder, Kubisch, Keller, & Stötter, 2020) and in the courts through cases taken on the issue of the State's response to climate change (McIntyre, 2020). The state is also taking measures to formalise learning about climate change at secondary school level as can be seen from the release of the Second National Strategy on Education for Sustainable Development (Government of Ireland, 2022). One of the objectives of this strategy is the introduction of a new senior cycle subject in 2024 entitled Climate Action and Sustainable Development (NCCA, 2022). This paper presents the results of research linked with learning about climate change in a formal education setting. The objective of the current research was to establish the efficacy and effectiveness of a climate change education intervention on the values, behaviour, attitudes and affect of a cohort of Irish secondary school students. The overall aim of the research is to further the evidence base concerning the effects of classroom-based climate change education interventions.

The first part of this paper outlines the different contexts relating to the topic. This includes a discussion of the international and national policy contexts, a brief review of the theoretical framework concerning environmental behaviour and a summary of the conclusions from the systematic review described in chapter 1. Part two considers the research design that was used for the study and explains how this approach addressed the different research

questions. Part three presents the results of the research. This part considers the effects the intervention had on a series of factors including biospheric values, hope, concern, knowledge, behaviour, and attitudes over three points in time. The final part of the paper consists of a discussion of the results in relation to the original hypotheses as well as a discussion of the results in relation to the wide, educational, and curricular context in Ireland.

3.2 The climate change context – international and national

Working Group I (WGI) of the United Nations' Intergovernmental Panel on Climate Change (IPCC) published its sixth assessment report in August 2021 (IPCC, 2021). Put simply, this report highlighted how the world's temperature is rising because heat-trapping blankets of carbon dioxide and other greenhouse gases continue to accumulate in the atmosphere, which means that less heat can escape into space (Lang, 2022). This report, six years in the making, was a stark reminder of the unprecedented, irreversible changes to the environment that are ongoing globally and that will result in catastrophic climate change for many species, including humans that live on this planet (IPCC, 2021). The IPCC's sixth assessment cycle did not just highlight the physical science behind climate change, however. IPCC Working Group II (WGII) reported on the potential impacts of and different options for adaptation to climate change (IPCC, 2022a) while Working Group III (WGIII) discussed ways to mitigate climate change (IPCC, 2022b). This mitigation report highlights how the best way stop global heating is to reduce CO_2 emissions by 50% by 2030 while aiming to reach net zero by 2050 (IPCC, 2022b). This would allow humanity to contain global heating to 1.5^{o} Celsius thus avoiding many of the climatic tipping points that would lead to irreversible damage to the biosphere within which human life is sustained.

Climate scientists advocate for change to occur at the international level between nations, at the national level through state policy in different sectors, at non-state level through transnational entities, and at the individual or household level (IPCC, 2022b). In terms of the need for change, the IPCC currently advocates for net zero CO_2 emissions from the industrial sector, a drastic reduction in methane emissions from the agricultural sector by 2030, the deployment of low emission energy sources to lock in greenhouse gases by the energy sector, and the development of national and local level policies that shift economic development towards sustainability approaches and post materialist consumer values, amongst others (IPCC, 2022).

The WGI report highlights how the current climate crisis has been brought about largely by the consumption and behavioural patterns of the wealthier, western countries, including Ireland (IPCC, 2021). The WGIII report goes further in mentioning the need to better design "choice architecture" to inform consumer decision making in a less environmentally costly manner while "addressing inequality and many forms of status consumption and focusing on wellbeing supports climate change mitigation efforts" (IPCC, 2022, p. 34). Some of the consumer behaviours highlighted as needing to change include dietary, transport and energy use patterns while the WGIII report and other academic reviews (Dietz, Gardner, Gilligan, Stern, & Vandenbergh, 2009) note that the greatest potential for climate change mitigation can potentially come from behavioural and cultural changes on the part of the countries that lead the way in global consumption and emissions. This is primarily due to the fact that individual consumer behaviour patterns concerning food, shelter, and transport account for upwards of 70% of greenhouse gas emissions when full production cycles are considered (Dietz, Gardner, Gilligan, Stern, & Vandenbergh, 2009). To give but one example, a demand-side strategy to reduce and

change building, dietary and land transport end-use consumption patterns could cut global greenhouse emissions by 40-70% in the medium term (IPCC, 2022b, p. 34). Within wealthier countries, consumer behavioural change related to end use of the above three sectors could result in an almost immediate reduction of greenhouse gas (GHG) emissions by 5% (IPCC, 2022b). The behavioural change discussed in the IPCC reports related to this rapid 5% drop includes a more plant-based diet, reducing food waste, walking and cycling more, home insulation and buying less disposable or unneeded goods. While individuals can and should take responsibility for their own behaviours related to GHG emissions it is important to remember that 100 corporate and state-owned fossil fuel companies are currently responsible for 70% of global emissions (Hyman, 2020). Individual stakeholders should completement any personal action taken with collective action aimed at encouraging states to legislate to assist corporate emitters improve their environmental credentials.

On paper, the Government of Ireland has been rapidly responding to climate change mitigation and adaptation since the adoption of the Paris Accords after the United Nations Climate Change Conference 2015 in Paris (COP21). This has included the drafting of climate change policies (Dept of Communications, Climate Action and Environment, 2019), a detailed Climate Action Plan (Dept of the Environment, Climate and Communications, 2021) and emissions reduction and climate change mitigation legislation (Climate Act, 2021). Despite this, Ireland still consistently ranks in the top 3 of GHG emitters per capita in the EU (CSO, 2021) since 2015. Ireland currently emits 12.1 tonnes of CO_2 per person compared to the EU's average of less than 8 tonnes (EPA, 2022). While many EU countries have already managed to stabilise their GHG emissions, Ireland's continue to rise at a rate of almost 5% per year (EPA, 2022b) with the Environmental Protection Agency warning (EPA, 2022b) that Ireland will drastically

miss its Climate Act targets to reduce emissions by 51% by 2030 (Department of the Environment, Climate and Communications, 2021).

3.3 The educational context

It is commonly acknowledged at international (UNESCO, 2020; IPCC, 2022) and national levels (Dept of Education and Skills, 2014) that education has a key role to play in encouraging positive behavioural shifts in relation to mitigation of and adaptation to climate change. Article 6 of the key United Nations treaty on Climate Change explains the crucial role that education, public awareness and access to information about climate change can have on changing the public discourse about climate change as well as acting as catalysts for positive change in a country's response to climate change (Mochizuki & Bryan, 2015). UNESCO emphasises that climate change education needs to place equal importance on different dimensions of learning to ensure effective action about climate change (UNESCO, 2021, see figure 9).

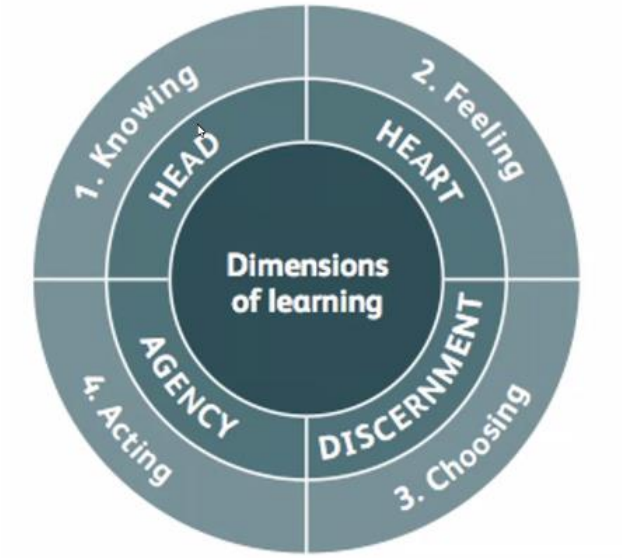


Figure 9:Four dimensions of learning about climate change (Hicks, 2019, p. 23)

References to sustainability have been peppered throughout the official State educational discourse for over a decade now through “Citizenship” values (NCCA, 2022a). Until recently climate change was generally a topic subsumed under sustainability at both primary (NCCA, 2020) and secondary (NCCA, 2022b) levels rather than a stand-alone topic in its own right. More recent policy changes have seen the impact of climate change on childhood as forming one of the rationales for the development of the new Draft Primary Curriculum Framework (NCCA, 2020). The Junior Cycle Framework currently includes learning about climate change through a cross-curricular approach aimed at integrating sustainability principles into various subjects such as science, CSPE, home economics and geography. A further policy change has been the publication of a background paper outlining the establishment of a new leaving cert subject entitled Climate Action and Sustainable Development (NCCA, 2022b) to be introduced as a pilot programme in September 2024.

3.4 Literature review summary

A literature review entitled *the outcomes of climate change education for primary and secondary aged children: a systematic review of quantitative research* was conducted as part of the current research. This review consisted of a systematic review conducted using the Weight of Evidence Framework (Gough, 2007) in accordance with the PRISMA guidelines for systematic reviews (Moher, Liberati, Tetzlaff, & Altman, 2009). An initial 3359 records were narrowed down to 9 studies based on a series of screenings and exclusion criteria. Different variables, including participant type, measures used, intervention type and results were discussed in a synthesis of the findings. The following were some of the key factors identified and discussed in the literature review.

3.4.1 Values associated with Climate Change related behaviours

The New Environmental Paradigm (NEP) is generally considered a good fit by researchers both in terms of measuring how biospherically oriented a person currently is as well as in predicting the absence or presence of pro-environmental behaviours (Dunlap, Van Liere, Mertig, & Jones, 2000). The current paper aims to explore the degree to which a classroom-based intervention can impact a person's environmental outlook as determined by the NEP scale (Dunlap, 2008). The paper also intends to discover whether there is an association between an increase in pro-climate behaviours (PCBs) and biospheric values.

3.4.2 Knowledge gain and behavioural change

The systematic review highlighted how many papers are epistemologically premised on the role that knowledge directly or indirectly plays in influencing environmental behaviour. Studies covering this area often aimed for more integrative approaches that incorporates factors as diverse as values (Stern, 2000), affect (Ojala, 2012), economic acumen (Chen, 2019), activism (Deisenrieder, Kubisch, Keller, & Stötter, 2020) and efficacy (Gottlieb, et al., 2013) into behavioural changes. For the most part however behavioural studies tended to focus on self-reported general behavioural intentions that were measured immediately prior to and immediately after an education intervention. Whether these changes were maintained into the longer term was not mentioned in any of the studies.

3.4.3 Formal learning approaches

Most climate change education interventions continue to take place within the classroom setting. Some programmes aimed at learning about climate change education aimed to mimic nature-based environmental programmes (Duerden & Witt, 2010; Baierl, Kaiser, & Bogner, 2022) and there is some evidence that suggests such programmes are more effective in increasing connectedness to nature (Frankel, Sellmann-Risse, & Basten, 2019) and biospheric values

(Martin & Czellar, 2017). Other studies suggest the absence or presence of formal learning approaches matters little in relation to environmental behaviour or attitudinal change (Collado, Staats, & Corraliza, 2013; Agirreazkuenaga & Martinez, 2021). For these studies the environment in which the learning took place was the key determinant of change. Understanding whether there is any longer term behavioural or values changes as a result of classroom based formal education approaches is one of the key aims of this research.

3.5 Methodology

3.5.1 Introduction

This chapter will briefly describe and provide a rationale for the choice of research methodology while also explaining the epistemological perspective of the researcher. The chapter includes an overview of the aims of the research and the research questions. The study design is discussed in terms of the participants selected, sampling techniques and data analysis used. Also included in this chapter are discussions on the reliability and validity of the study, ethical issues, and research reflexivity.

3.6 Aim of the study

The systematic review of research literature relating to the impact of climate change education (CCE) interventions on values, attitudes, and behaviour found that further research was warranted. A quasi-experimental approach was utilised to assess the impact of a high-quality, student centred, transformational, classroom based CCE intervention on secondary students' behavioural intentions, values, and attitudes. The primary aim of the study was to build on previous research within the field of climate change education and to further the evidence base concerning the effects of a classroom-based climate change education intervention. The study also aimed to be the first to explicitly highlight what, if any, impact that CCE has on the

biospheric values that partially underpin the New Environmental Paradigm model of environmental behavioural change (Dunlap, 2008).

3.7 Research question and hypotheses

The research questions developed from the systematic literature review primarily involved exploring the relationship between a climate change education intervention and knowledge, attitudinal and behavioural outcomes in secondary school-aged students in Ireland. The specific research questions that arose were:

- Does exposure to a classroom-based climate change education intervention change students self-reported environmental behaviours, knowledge about climate change and efficacy about acting on issues relating to climate change?
- Is an 8–10-hour CCE intervention sufficient to positively alter students' biospheric values?

The following hypotheses were developed based on these research questions:

- Hypothesis 1: An increase in the level of different knowledge types learnt (system, action & effectiveness) will lead to a concurrent increase in the self-reported levels of practice of PCBs
- Hypothesis 2: Post intervention, participants will self-report higher levels of environmental efficacy than in the pre-intervention condition
- Hypothesis 3: Post intervention, participants taking part in the CCE condition will self-report less worry and more hope than students in the control condition.

- Hypothesis 4: Post intervention, participants taking part in the CCE condition will self-report more PCBs both at household, school, and community level than in the pre-intervention condition
- Hypothesis 5: Participation in the intervention will lead to higher levels of environmental values and lower levels of egotistical values amongst students.
- Hypothesis 6: All post-intervention effects will be maintained at a six-month follow-up review

3.8 Research Design

A quasi-experimental within-subjects repeated measures design was used to evaluate the effects and efficacy of the CCE intervention on students' behaviour, values, and attitudes. This was done to help determine the feasibility of classroom based CCE as a viable pro-environmental behavioural (PEB) intervention. Initially, a between subject's design was proposed in which results would be gathered and compared from an experimental group taking part in the CCE intervention and a control group who would complete pre- and post-test surveys prior to engaging in the climate change intervention. This design would have allowed for a better causal inference by examining how measures of the dependent variables changed differently between different conditions. The design had to change for reasons of contamination outlined in the next section.

A within subject or repeated measures design was deemed appropriate for several reasons, chiefly:

- Within subject's designs can track the effect of a variable over time more easily than a between subject design

- There is the potential for a greater statistical power even with smaller participants numbers. This is important in studies where a high attrition rate has to be planned for
- Repeated measures designs are less time consuming and easier to run than experimental approaches, something that is important given the time constraints that this body of research fell under. (Minitab Statistics, 2015) (Maciejewski, 2020)

Data for the research was collected from students using self-report online questionnaires hosted on Google Forms. Generally, studies examining environmental behaviour changes depend on self-reported behaviours documented through questionnaire surveys (Bofferding & Kloser, 2015; Ignell, Davies, & Lundholm, 2019; Oerke & Bogner, 2011). The validity of self-reported behaviours in predicting PEB has been corroborated (Warriner, McDougall, & Claxton, 1984, quoted in Wu and Otsuka, 2020) while responding with socially desirable answers has been found not to be a major factor on environmental behaviour for adolescents (Oerke & Bogner, 2011). As such, this study will also measure PCB, environmental values and attitudes through self-reported responses collected on Google Forms using school computers.

3.9 Sample

A purposive, tiered sampling approach was used to recruit participants to the study. The sample is tiered because the researcher reached out to a variety of schools across Ireland to invite their involvement in the study. After an initial meeting with the principal to explain the study, teachers were selected to co-facilitate/ supervise the CCE intervention. These teachers then shared the survey material with the participating students. The sample can be considered purposive because the researcher used their own judgement when choosing schools and teachers to participate in the research. The CCE programme was developed for students within the age range of 12-15. A total of five second year and one first year class across four schools took part

in the intervention. The schools were split evenly between urban and rural environments. All schools were mixed schools and two of the schools had Delivering Equality of Opportunity in Schools (DEIS) status.

The statistical programme G*Power was used to conduct power analysis prior to conducting the research. Adhering to Cohen's (1988) guidelines for small (r = 0.1), medium (r = 0.3) and large (r = 0.5) effect sizes, a two tailed alpha of .05 was assumed for tests. With one cohort, an assumed error probability of .05 among repeated measures as well as a medium effect size (0.18) and a power of 0.95, the minimum recommended sample for the study was $n = 81$.

The research initially intended to use a control group as part of the study. For this reason, each school accessed was asked to volunteer two classes, one as a control group and one as an experimental group. There were contamination effects from using a control group from the same school as the experimental group which affected the post test results, however. This primarily involved students from the control groups asking teacher to learn about climate change and making climate change posters to hang in the corridors of the schools, one of the activities that students in the experimental group were asked to conduct. Consequently, the control group results could not be used. Attempts were made to access other schools, both through contacting schools directly while also contacting Education and Training Board (ETB) district officers so as to access non-contaminated control groups. As no schools were forthcoming the study had to be changed from a between groups repeated measures study to a one-group study.

3.10 Participants

Whole class groups were invited to participate in the intervention with no exclusion criteria relevant to individual students. One student was moved between two participating classes during the intervention however it was possible to avoid duplication of results while respecting

their own wishes to continue to participate in the intervention. Participants comprised first and second year students from four mainstream post-primary schools in Ireland. The number of participants that engaged in the research was 89 broken down into 45 male and 44 female students. 7 students were absent for either the post-test or follow up test and these student's results were considered incomplete and removed from the final data sets to be assessed. Fifty-one of the students (25 female, 26 male) attended DEIS schools.

3.11 Measures

This study used instruments that have been found to be both reliable and valid through other research. The following section gives an outline of the instruments together with their Cronbach's alpha scores for internal consistency and any intercorrelation scores between the instruments from other research projects. All instruments were designed for adolescents unless otherwise stated. The factor loadings, item level Cronbach's alpha scores and test items can be found in Table 6.

The different instruments were developed into an online research survey medium (Google Forms) consisting of 150 Likert type and multiple-choice questions. The survey was tested by a cohort of 22 students in a school in the west of Ireland. This piloting established that the survey was accessible to students and could be completed within a 25-minute time frame. Minor spelling corrections were made at this point and areas that would need further verbal explanation to students were identified and highlighted for improvement.

Table 6: Table of survey instruments

Name of instrument	Measuring	Author	Cronbach's Alpha	Other measures of reliability/ validity
Adolescent Climate Change Hope Scale	Hope for the future when considering climate change.	(Stevenson, Nils Peterson, & Bondell, Developing a model of climate change behaviour among adolescents, 2018)	$\alpha = 0.75$	Eigenvalue <1 therefore scale is unidimensional, measuring just the hope factor
Pro-environmental behaviour scale for adolescents and children	Self-reported participation in climate change mitigation behaviours	(Stevenson & Nils Peterson, Motivating action through fostering climate change hope and concern and avoiding despair among adolescents, 2015)	$\alpha = 0.67$	Eigenvalue <1 therefore scale is unidimensional, measuring just the environmental mitigation behavioural factor
Environmental Portrait Value Questionnaire (E-PVQ)	Value orientations and environmental beliefs	(Bouman, Steg, & Kiers, 2018)	Range α =0.63- 0.88 for 4 factors	4 factors identified. Two pairs of factors correlate with each other (same as other studies for these values) strong correlation between biospheric values and environmental self-identity
Climate change concern	Climate change risk and concern about climate change	(Stevenson K. , Peterson, Bondell, et al., 2013)	α=0.67	Eigenvalue <1 therefore scale is unidimensional, measuring just the concern factor
Two Major Environmental Values Scale (2-MEV	Environmental Preservation-Utilisation scale developed for adolescents	(Bogner & Wiseman, 2006)	α=.84	

3.11.1 Module Contents

The material for the intervention was developed by the researcher based on UNESCO best practice guidelines for environmental education together with researching available modules that had been previously proven to change pro-environmental behaviour and increase attitudinal and values changes (Hermans & Korhonen, 2007). A full list of activities, their basis in research and the rationale for including them can be found in appendix 6. Some of the materials in these activities are also based on themes identified in the development of a short course on climate change developed by Irish teachers (Minnock, Sullivan, & Dick, 2021). The material aims to connect students with local climate change impacts and encourage students to collect information and discuss and draw conclusions together from the collected material which foster ownership at a student level over local climate change initiatives (McNeal, Petcovic, & Reeves, 2017). The modules also aim to improve young people's views on their capacity to effect change on individual and local levels (Ross, Rudd, Skains, & Horry, 2021) (Rudd, Horry, & Skains, 2020).

3.11.2 Learning objectives and core skills for CCEP

The modules focused on facilitating and empowering young people to become confident and informed climate change actors on climate change issues. The aim was for participants, upon completion of the programme, to:

- Have improved communication skills
- Have improved group work and facilitation skills
- Have an understanding of climate change causes and effects
- Take action with their peers and family to combat climate change

Each module took between 2 and 2.5 hours to complete. The core skills and knowledge points contained within the modules were:

- Module 1: Intro to Climate change, causes of climate change, climate change causes in Ireland
- Module 2: Intro to ecosystems; Climate Change effects on eco systems in Ireland and the world, tipping point for climate change
- Module 3: Climate Change mitigation and adaptation strategies – identifying Individual, family, local, national, international
- Module 4: Coping with climate change – a change in mentality, a change in behaviour

3.12 **Interaction with schools**

Interaction was through the following stages:

1: Contacting principals to explain the purpose and details of the intervention and seeking permission to carry out the CCEP in their school. Principals were asked to identify the level of CCE instruction and CC awareness already in school

2: Information sheets and consent/ assent forms distributed to the parents and 1st year students taking part (Appendices B & C)

3: Pre-survey presented to participants with supports from researcher for students' range of abilities (Survey time point 1)

4: Researcher will implement four 2-2.5-hour modules accompanied by teacher (see Appendix A)

5: Researcher supports students to complete post-tests (Survey time point 2)

6: Distribute 6 month follow up surveys (Survey time point 3) to participants to explore maintenance of intervention effects

3.13 Ethical Considerations

Research was guided by the Psychological Society of Ireland's (PSI) Code of Ethics (Psychological Society of Ireland, 2019) as well as the Data Protection Act (2018). The research proposal was reviewed by the Research Ethics Committee of Mary Immaculate College, University of Limerick, also. Approval was granted for the study in February 2022. All materials used by students followed the Universal Design for Learning Principles in that material was explained so that all students were able to complete the survey forms and fully take part in the intervention (Hall & Murray, 2010). Some of the principal ethical concerns considered and addressed include the following:

3.13.1 Informed consent

The PSI's Code of Ethics (2019) makes clear the importance of obtaining informed consent from both adults and children. The current study sought informed consent from parents using an information sheet that detailed information about the research, the doctoral course they were studying on, the purpose and nature of the research, confidentiality, anonymity, and the right to withdraw from the study (appendix 7). Informed consent was also sought from school staff at teacher and management level (appendices 8 & 9) Informed consent was also obtained from students using an information sheet that followed the Universal Design for Learning Principles (Hall & Murray, 2010) (appendix 10). The purpose of the research together with the assent form was read out to each participating class at the commencement of the intervention. Participants were asked as a group and then individually just prior to the pre-test measure as to whether they had any questions or concerns about the research. It was also explained to students both before and during the survey that participation in the survey was voluntary and optional and that any student who wanted to withdraw could do so at any time they choose. The link for the

online survey with the section on informed consent is here:

https://forms.gle/sGqqmEBPZcAWh2Zq5

3.13.2 Confidentiality

The PSI's Code of Ethics (2019) also makes clear the responsibility of the researcher to limit the collection of information only to that which is relevant to the research. The Code of Ethics also details the importance of limiting access to and correctly storing information that is personally identifiable. For the purposes of this research the issues of confidentiality and anonymity were explicitly addressed throughout. The names of class teachers and students were collected initially however each student self-assigned a four-digit number based on their telephone number which was then used to link pre and post-tests. As soon as the data was downloaded onto the researcher's computer all identifying features were deleted and the 4-digit number formed the sole basis of each student's identity. The information sheets explained how none of the data saved on the researcher's laptop could be linked with any individual student other than through this number.

3.14 Data Analysis

In order to address both the first research question relating to climate change behaviours, attitudes, and knowledge and the second research question relating to biospheric values, it was necessary to develop a questionnaire to be administered at pre-intervention, post-intervention, and follow-up stages. Data analysis over 3 time points requires an analysis of variance calculation (ANOVA) which was used to address both research questions.

Data was collected on Google Forms before being downloaded into a Microsoft excel comma separate values (CSV) file. As this data is transferred automatically there was no coding errors. The data was cleaned of any identifying features and all responses were transformed into

numerical values (see appendix D). The CSV numerical data was then transferred into the Statistical Package for the Social Sciences (SPSS, v28; IBM) file for analysis. SPSS was used to conduct a descriptive analysis, tests of sphericity, tests of effect size and an analysis of variance over three points in time. The data was then analysed to determine participant's own views of their knowledge, attitudes, and behaviour and whether changes had occurred in these over time. SPSS was also used to generate the tables and charts found in the results section. Paired samples t-tests were then run in order identify any statistically significant differences in the participant scores from Time 1 to Time 2 and from Time 2 to Time 3.

3.15 Results

The current research aimed to explore the effects of a 10-hour climate change education intervention on the values, attitudes, affect, and behaviour of secondary school age students. These dependent variables were measured just prior to the intervention taking place, just after the intervention was completed and again at a six month follow up time. The results of this intervention study are presented in this section.

Data was gathered from 82 (42 male) participants who completed all four modules of the CCE intervention and who completed the survey over three points in time. A univariate within groups repeated measures analysis of variance (ANOVA) assessment was run to determine whether the intervention had an effect on the independent variable, time (see table 7). Overall, there was a statistically significant main effect for time ($F_{(14)} = 12.33$, $p < .00$, $\eta^2 = .73$). This tells us that the variables measured over time changed between the time of administration of the pre-test and post-test and again between the post-test and follow up test. The eta squared statistic (.73) indicated a large effect size.

Table 7: Descriptive Statistics, $M^{((sd)}$

Variable	Pre	Post	Follow up
Hope	$26.56^{(6.1)}$	$29.63^{(5.68)a}$	$27.31^{(6.26)b}$
Concern	$9.04^{(3.13)}$	$7.72^{(2.56)a}$	$8.51^{(2.93)b}$
Behaviour	$29.06^{(8.49)}$	$23.59^{(6.91)a}$	$27.96^{(7.06)b}$
Efficacy	$12.26^{(4.27)}$	$10.54^{(3.18)a}$	$12.45^{(3.24)b}$
Knowledge	$11.46^{(4.19)}$	$14.31^{(3.49)a}$	$12.13^{(3.72)b}$
Biospheric values	$15.83^{(3.27)}$	$18.94^{(4.23)a}$	$16.44^{(3.71)b}$
Egoistic values	$14.58^{(3.08)}$	$17.24^{(3.17)a}$	$16.22^{(4.31)ab}$

[a] statistically significant effect relative to pre-test

[b] statistically significant effect relative to post-test

Sphericity signifies the degree to which the variances of the differences between the levels of different groups are equal (Laerd Statistics, 2022). Repeated-measures ANOVAs are particularly susceptible to the violation of the assumption of sphericity therefore different tests of sphericity were run. Mauchly's Test of Sphericity indicated that the assumption of sphericity had not been violated for behaviour, hope, concern, efficacy or biospheric knowledge. The tests for egoism (x^2 (2) = .891, p = .012) and knowledge (x^2 (2) = .843, p = .002) were statistically significant, however. Therefore, these two variables violated the assumption of sphericity (p<.05), and the Greenhouse Geiser correction was applied. All variables indicated a statistically significant effect for time (see table 8).

Table 8: Univariate results

Effect	*df*	F	*P*	η^2
Hope	2	10.53	<.001	.12
Concern	2	7.82	<.001	.09
Behaviour	2	24.55	<.001	.24
Efficacy	2	10.49	<.001	.12
Knowledge	1.7	14.26	<.001	.16
Biospheric values	2	28.45	<.001	.27
Egoistic values	1.8	12.44	<.001	.14

The univariate calculation showed a statistically significant effect for all of the variables across time therefore pairwise comparisons were run to show the effect between pre, post, and follow up variables. All variables demonstrated a statistically significant result between pre- and post-however all variables with the exception of egoistic values demonstrated a statistically significant change in the opposite direction between post-test and follow up assessments. In relation to egoistic values, the pre-test mean score of 14.58 changed to a statistically significant mean score of 17.24 immediately following intervention, signifying a decrease in egoistic values. At the six month follow up point the egoistical values mean (16.22) increased slightly but remained significantly different to the pre-test scores. Said differently, after an initial statistically significant change amongst the variable as a result of the intervention, nearly all variables largely reverted back towards the baseline at the six-month follow-up mark. These results suggest that, in the short term, CCE interventions can lead to an increase in the different system, action and effectiveness knowledge types (hypothesis 1), higher levels of environmental efficacy

(hypothesis 2), a decrease in worry or anxiety and a concurrent increase in hope for the future concerning climate change (hypothesis 3), higher levels of climate change related behaviours (hypothesis 4), lower levels of egotistical values |(hypothesis 5) and higher levels of biospheric values (hypothesis 5). However, in the medium, six-month plus, term these research results suggest that hypothesis 6 is not supported.

In conclusion, the results of the current research suggest that formal, classroom-based climate change education can be efficacious in the short term in bringing about positive climate change related behavioural and attitudinal change. Without reinforcement of the intervention material the change increase between the pre-intervention results and the 6 month follow up was too small to be considered statistically significant. These results will be reviewed in more detail in the discussion section below.

3.16 Discussion

This study aimed to explore the effects of a classroom-based intervention about climate change on a series of variables. Variables considered by the study include the self-reported practice of climate change related behaviours, hope, efficacy, and concern in relation to climate change, knowledge about climate change, and biospheric and egoistic values that can have an impact on climate change. This chapter begins with a discussion on the implications of the results of this study, using examples such as posters and letters from the climate change education intervention carried out. It then interprets these results with reference to existing literature. It then describes some methodological considerations that could be considered strengths and limitations of the current study and discusses ways to address the weaknesses in future research.

3.17 Research Aims

The research aimed to answer the following research questions:

1) Does exposure to a classroom-based climate change education intervention change students self-reported environmental behaviours, concern about climate change, knowledge about climate change and efficacy about acting on issues relating to climate change?
2) Is an 8–10-hour CCE intervention sufficient to positively alter students' biospheric values?

Based on the results of previous research, it was expected that the CCE intervention would lead to an increase in participant's knowledge of climate change related issues (Nourmoradi, et al., 2021; Flora, et al., 2014; Arya & Maul, 2016). Environmental behaviour models such as the Adolescent Climate Change Behaviour model (Stevenson, Nils Peterson, & Bondell, 2018) informed Hypothesis 1, which predicted that this increase in knowledge leads to an increase in hope and concern about climate change. These increases together with the attitudinal and efficacy changes included in hypotheses 2 and 3 then lead to an increase in the pro-environmental or climate change related behaviours practiced by the person, as outlined in hypothesis 4.

3.18 Key Findings: Research Question 1

In general, empirical research on the effects of climate change education within the Irish secondary school context is limited. Empirical research on the impact of climate change related educational interventions on Irish students' behaviour and attitudes is, so far, non-existent. The theoretical frameworks included in the current study were conceptualised by a wide body of international researchers and used to develop general curricular guidelines to be subsumed into

national level practices. The current study examines whether those international frameworks can be effectively incorporated into the Irish context. The research results suggest that a 10-hour classroom-based climate change education intervention can significantly alter Irish secondary students' knowledge, attitudes, values, and behaviour in the short term. Similar to previous research carried out (Arya & Maul, 2016; Bouman, Steg, & Kiers, 2018; Dunlap, Van Liere, Mertig, & Jones, 2000; Flora, et al., 2014; Johnson & Činčera, 2021; Nourmoradi, et al., 2021) participation in the intervention predicted a significant increase in knowledge about climate change. This significant increase in knowledge occurred both for general scientific questions related to the causes and effects of climate change as well as more specific questions related to climate change within the Irish context. Concurrent to this, students' hope for the future, concern about climate change and sense of efficacy in relation to what they, their families and communities could do about climate change all increased as a result of the intervention. After taking part in the intervention, students were able to better understand how to mitigate for and adapt to climate change at different systems levels. This included what they as individuals could do, what family activities could help prevent climate change, how schools could come together to impact climate change and actions that needed to be taken on national and international levels, in line with Climate change education best practice. As explained by the Adolescent Climate Change Behaviour model (Stevenson, Nils Peterson, & Bondell, 2018), an increase in these variables should be sufficient to positively alter the level of climate change related behaviours being practiced by the students. This is further substantiated by other research suggesting that factors such as knowledge, belief in the efficacy of the actions being taken and motivation explain roughly 65% of the variance in the formation of PCBs (Ali Khan, Karpudewan, & Annamalai, 2021). Results from the current study bear this out as participation in the intervention

led to an increase in the self-reported practice of behaviours linked with climate change mitigation and adaptation. Some examples of the knowledge and climate change efficacy gains made by students comes from posters that they created at the end of the last climate change module (see appendix 14).

As can also be seen from the participant posters, knowledge gains on how to combat climate change brought about by the intervention were made over all three levels of the knowledge structure model (Frick, Kaiser, & Wilson, 2004). Evidence of system knowledge can be seen from the cause and effect in the posters, such as how cows release methane which in turn leads to global warming (see appendix 14). All of the posters show clear examples of action knowledge – knowledge representative of how a person comprehends what type of action or behaviour might influence a given climate change action. Turning off light, closing windows or using sustainable transport to get to school are examples of action knowledge within the education setting. Buying local produce and reducing the use of single use plastic are examples of different forms of action knowledge demonstrated in the posters developed through the CCE intervention. Examples of effectiveness knowledge – the relative gain that is associated with different behaviours – were less easy to identify on an individual or family level from student responses although, as can be seen from all of the posters, many clear examples of effectiveness on a policy or national level could be identified, often related to transport, agriculture, or patterns of consumption.

Despite the specific focus on activities and examples related to climate change, many environmental practices unrelated to climate change were included also on the posters. The main example of this is littering. One poster includes the idea of imposing fines on people who litter while two others include the concept of stopping littering as examples of climate change

mitigation behaviours. Assisting pollinators or halting biodiversity loss through the planting of wildflowers was another consistent example of the conflation of general environmental practice with climate change mitigation activities that occurred even after the completion of the intervention. There is already a heavy emphasis within both formal subjects that deal with the environment such as geography and SPHE as well as the green schools projects on littering and biodiversity loss which perhaps explains the continued emphasis on these topics in relation to climate change.

The CCE intervention emphasised actions that could be taken at both individual and collective levels to combat climate change. These actions were both direct and indirect pro-climate behaviours. Students often overemphasised the importance of simple, direct actions such as reducing the use of single use plastic at the expense of indirect or more complicated actions involving other stakeholders. As can be seen in the posters, many examples of both individual and collective action involve simple actions, such as turning off white products or purchasing more sustainable food produce. The last module in the CCE intervention focused on writing letters to a national NGO that establishes and conserves woodland areas in Ireland. Students wrote letters to this NGO requesting that they support the students in tree planting efforts in the area nearby the school (see appendix 15)

3.19 Key Findings: Research Question 2

This research also considered the role that a climate change education intervention can have on biospheric and egoistical values. Hypothesis 5 predicts that participation in the intervention will lead to to higher levels of environmental values and lower levels of egotistical values amongst students. According to the Value Belief Norm model (Stern, 2000), the absence or presence of biospheric values can help to predict the absence or presence of pro-environmental

behavioural norms. The current research found that a 10-hour classroom-based climate change education intervention could increase Irish adolescents' affinity with nature and increase the degree to which they profess respect for the environment in the short term. However, results from the current study do not suggest that any gain in pro-environmental beliefs or biospheric values are maintained in the medium to long term. In the current study self-reported biospheric values, while still higher than the pre-test scores, had dropped significantly at the third point in time when compared to the post-test scores.

The CCE intervention focused not only on learning about climate change but also on learning about ways to effectively practice climate change mitigation and adaptation actions. This class-based exploration of ways to carry out pro-climate behaviours related to diet, consumption, and transport, amongst other behaviours, has been linked to the strengthening of biospheric values and the practice of positive climate change related behaviours (Kaniušonytė, 2019). The increase in biospheric values could be linked to increases in environmental concern and perceived competency at practicing particular environmental behaviours learnt through the CCE intervention as much as any attitudinal or knowledge shift (Roczen, et al., 2013).

Egoistic values were included in the current study because more current research (Ignell, Davies, & Lundholm, 2019) suggests that the strength of a person's egotistical identity will act as a stronger moderator than a person's biospheric values on the number and type of pro-environmental behaviours carried out. Interestingly, as well as the rise in biospheric values as a result of participating in the CCE intervention, the current study noted a concurrent decrease in egoistic values, as defined by the New Environmental Paradigm (Dunlap, Van Liere, Mertig, & Jones, 2000). For instance, in both the post intervention questionnaire and the six month follow up survey, responses to egoistic questions relating to the importance of control over other's

actions and the importance of being ambitious decreased significantly and remained at a reduced level. This study did not undertake any analysis related to the moderating effect that learning about the biosphere or humanities place in the global eco system might have on egoistic values, however.

Similar to many other student-centred, project based, climate change education interventions, the current study found significant increases within the knowledge, behaviour and attitude variables immediately after the completion of the study (Wu & Otsuka, 2021; Arya & Maul, 2016; Deisenrieder, Kubisch, Keller, & Stötter, 2020; Zografakis, Menegaki, & Tsagarakis, 2008; van de Wetering, Leijten, Spitzer, & Thomaes, 2022). No previous research studies have been found that consider the longer-term effects of classroom based CCE interventions. Results from the current study clearly show that the initial increase for all variables is followed by a decrease across the variables towards the pre-test survey results. The only variable that bucked this trend was egoism which, while decreasing somewhat still registered a significant increase in comparison to the pre-test results 6 months after the intervention was completed. This result suggests that follow-up studies are key in identifying the true effects of behavioural change linked to CCE interventions.

3.20 Limitations for research

There were several limitations in the current study that could potentially have affected its reliability and validity. Chief among these was the lack of a control group, thus limiting the experimental effectiveness of the study. Despite this, the most recent literature review on environmental education (van de Wetering, Leijten, Spitzer, & Thomaes, 2022) does include single group pre-post-test designs despite their methodological limitations. Such studies form the majority of CCE related interventions that could be found, both in the systematic review

conducted for this study as well as in other reviews (van de Wetering, Leijten, Spitzer, & Thomaes, 2022) , no doubt because of the real world limitations of conducting experimental and quasi-experimental research in the working school environment. The presence of a control group could potentially have increased the internal validity of the study and ensured that the causal relationship between the intervention and the variables being measured wasn't being confounded by other activities in the school. The study did attempt to limit this by asking participating school staff to avoid the formal teaching of climate change over the duration of the experiment.

The data collection, education interventions and data analysis were all conducted solely by one researcher. The reliance on a sole researcher can be considered to have both positive and negative consequences to the reliability and validity of the study. On the positive side, there are benefits to the construct validity of the study by relying on a single facilitator to deliver homogenous interventions across all schools. This results in a consistent, uniform message being shared in each school together with the same focus and emphasis on specific parts of the activities in each of the modules. On the negative side, reliance on a sole researcher can also lead to an increased risk of Experimenter bias and even the Confirmation Effect in cases where the researcher is trying to prove the effectiveness of an intervention that they have created themselves (Webster & Sell, 2014). Several conscious decisions were made on the part of the researcher to minimise these risks. Firstly, the intervention content and research process were vetted by a university ethics committee partly to ensure a high standard of objectivity could be maintained by the researcher at all stages of the study. The research process and protocol were formally outlined in detail as part of the ethics application and were adhered to throughout the study also. The protocol included the use of anonymous data collection, previously validated data collection tools, the researcher staying at a remove from the data collection process in the

classroom and other techniques outlined in chapter 4 to ensure objectivity and reduce experimenter bias. Finally, the research in question was not aimed at proving the effectiveness of a particular researcher developed classroom based CCE intervention, rather it was aimed at understanding the effects of classroom based CCE, in general. This difference facilitated the researcher in maintaining objectivity throughout the process and limited any propensity towards confirmation bias in terms of the hypotheses or research questions.

The use of schools over a wide geographical and socio-economic range helped increase the external validity of the study and enhancing the generalisability of the results to the Irish context, at least. Choices had to be made between using several facilitators or having just one researcher deliver the intervention, and this could potentially have positive and negative impacts on the external validity and general reliability of the study. These are discussed in greater depth in Chapter 3 of this study. The systematic review of the literature recognised how the vast majority of studies in this area either focus entirely on an increase in knowledge or an increase in knowledge and self-reported behaviour (Steg & Vlek, 2009). While the current study did avoid the pitfall of focusing solely on environmental knowledge increases as the basis of determining effectiveness, something that has previously been highlighted as an issue with such research (Ardoin, Bowers, Roth, & Holthuis, 2018), it was not able to avoid using self-reported measurements to measure behavioural change. The correlation between self-reported levels of behaviour and actual behaviour has previously found to be quite low in environmental conditions (Corral-Verdugo, 1997) and this is another threat to the validity of the study.

The results of the current research suggest that formal, classroom-based climate change education can be efficacious in the short term but that, without reinforcement of some kind, less effective after a period of 6 months has passed. Previous studies (Sellmann & Bogner, 2013;

Parant, Pascaul, Jugel, Kerroume, & Gueguen, 2017) had already considered the lack of a persistent positive effect on attitudes or behaviours from short, classroom based, one or two hour interventions and the current study suggests that without revision of the material this lack of a lasting effect continues even with 10 hour programmes that meet all of the criteria for sustainable education as set out by UNESCO (2020). Similarly, this study has shown that secondary school students' values can change through participation in a climate change education intervention in favour of biospheric values and at the expense of egotistical values, a factor which has been found to hinder pro-environmental behaviour. Similar to the results of the first research question, it seems that changes to students' values do not last in the medium term and that some form of maintenance intervention is most likely needed to ensure a more lasting effect.

3.21 Recommendations for research

Further research on what constitutes effective climate change education within the context of behavioural change at secondary school level is warranted. This research would ideally incorporate a longitudinal aspect aimed at measuring whether self-reported attitudes and values continue to revert towards the base line after a 12-month. Similar research involving the effect that a maintenance intervention at a six month follow up period might have on medium- and long-term results should also be considered. If scores revert to the baseline even after maintenance interventions have been carried out, then State policy on the development of the climate change and sustainability curriculum should consider what aspects other than classroom-based learning could be incorporated into the new curriculum.

Studies at primary school level have identified letter writing activities and quantifying the student's own reduction of carbon emissions as useful in bringing about behavioural change (Sumrall & Sumrall, 2021). Still other research has identified that bridging the knowledge gap

about how to act environmentally, as opposed to why to act environmentally is important in encouraging younger generations to move towards climate friendly behaviours (Kaniušonytė, 2019) (Frick, Kaiser, & Wilson, 2004). Similar to the Action strand outlined in UNESCO's (2010) climate change awareness strategies[1], it is envisaged that the teaching and practice of particular behavioural actions could lead to increased efficacy levels and climate change related behaviours being practiced. Studies involving group activities such as letter writing, tree planting or energy use surveying could increase the internal locus of control with student's perceptions of climate change as a solvable issue. This, in turn, could lead to students taking further action to mitigate against climate change. In short, a move away from solely system strand based CCE programmes and towards programmes that use practical, student led activities to increase efficacy in the action and effectiveness strands should allow for more last positive results in PCBs and biospheric values.

3.22 Conclusion

This study demonstrates that CCE interventions can have a positive short-term impact on the attitudes, efficacy, knowledge, affect and behaviour of secondary school age students. However, further research is needed to understand how best to maintain these effects into the medium term and beyond. Priorities for the research field include a move away from research based around knowledge and self-reported behaviours related to climate change and towards the

[1] 1. System Strand: What the climate change and the greenhouse effect are
2. Action Strand: How human behaviours can impact, mitigate, and adapt to climate change
3. Effectiveness Strand: Which behaviours are most effective in meeting a particular mitigation or adaption goal (UNESCO, 2010).

study of actual behaviours. From a policy perspective, this research could help to inform policy makers of the need to consider alternatives to exclusively classroom-based learning about climate change.

4 Critical Review and Impact Statement

4.1 Introduction

Chapter 3 of this thesis consists of a critical reflection on the study from a number of different perspectives, together with a consideration of how the research undertaken might potentially impact the theory and practice of climate change education. This chapters begins by examining the epistemological and ontological framework through which the study was conducted. The rationale for the choice of topic and methodological design is then considered. The chapter then discusses some of the strengths and weaknesses of the research with a particular emphasis on the impact that some of the ethical dilemmas faced had on the research. The next section then considers the implications of the research, from practical, academic, and psychological perspectives. The chapter concludes with an impact statement explaining how the thesis makes a distinct contribution to the knowledge of the subject.

4.2 Epistemological and ontological perspectives

Kuhn can be usefully paraphrased to help define the psychological paradigm as the set of universally recognized psychological empirical achievements that, for a time, provide model problems and solutions to a community of psychological practitioners (Kuhn, 1996, p. 10). It is important for psychological researchers to delineate the paradigm or paradigms that their research is being conducted through as this highlights the researchers' awareness of the epistemological and ontological structures that they are working within also (Bracken, 2010).

This should, in turn, provide an exemplar for the researcher to understand and identify the impact of different historical, cultural, and philosophical contexts on their research rationale, data analysis techniques, and interpretation (Tomlinson, 2023).

The current study follows what is considered as a traditional scientific approach to applied psychology (Barker, Pistrang, & Elliott, 2002). This is the hypothetico-deductive method in which the practitioner moves from a theory to a hypothesis to an experiment to test that hypothesis (Popper, 1959). In terms of its theoretical underpinnings, this research is conducted within the Value Belief Norm model (Stern, 2000) of the New Environmental Paradigm (NEP) (Dunlap, Van Liere, Mertig, & Jones, 2000; Bernstein & Szuster, 2019). This is very much a pragmatic paradigm created by researchers to stand as a counter to what they consider the Dominant Social Paradigm (DSP) of industrial and post-industrial capitalism (Davis & Stroink, 2015). The DSP values of individualism, material abundance and primacy of economic growth are replaced with an "implicit cognitive tendency to value and respect nature as well as to … maintain a pro-environmental orientation" in the NEP (Davis & Stroink, 2015, p. 578).

The current research works within the pragmatic paradigm that you may hold different ontological perspectives, or ways of viewing reality and the actions taken within those realities at the one time (Bracken, 2010; Gallagher, 2008). This study deliberately holds this view in order to avoid the pitfalls of induction, in particular positivist, verificationist and theory dependent approaches (Barker, Pistrang, & Elliott, 2002) in overstating the role of a given variable, such as knowledge, in providing an explanation for changes in another variable, such as behaviour related to climate change.

This research subscribes to the concept of social ontology, or the idea that the human world is made up of social entities, which cannot be removed or exist independently from the

social actors that construct them (Ormston, Spencer, Barnard, & Snape, 2014). The CCE intervention that is discussed in this research is a social construction that aims to sway others towards a new meaning framework that has the NEP paradigm at its core, in much the way that different models of climate change behaviour change suggest happens with exposure to climate change education interventions (Stevenson, Peterson, & Bondell, 2018). On the other hand, the climate change science that informs the CCE intervention is considered from an objectivist position, that is that the human-caused changing climate on Earth is a reality that physically exists independently of any meaning which humans ascribe to it. Epistemologically, one could argue that research of this nature about behavioural change could exist within a positivist perspective based on behavioural change occurring through a gathering of unchangeable facts about climate change (Crotty, 1998). This sort of approach is often taken with quantitative research which can be statistically analysed (Parahoo, 2014). This positivist approach should be tempered with the fact that the research is premised on several different interpretivist theoretical frameworks (Ormston, Spencer, Barnard, & Snape, 2014). This includes the aforementioned Value-Norm Theory of Environmentalism which posits that a person's values, concern for the environment and effective knowledge level can all affect their environmental behaviours (Stern, 2000) as well as the Knowledge Structure Model which details how different types of knowledge can affect not only behaviour but efficacy and values also (Kollmuss & Agyeman, 2002).

4.3 Rationale for choice of topic

The topic of this research was initially chosen more for intrinsic than for extrinsic reasons. The negative effects of climate change are something that the researcher experienced first-hand while working in Southern countries. Upon return to live in Ireland the public concern for and take-up of pro-climate behaviours appeared limited when compared to other places.

Research suggests many reasons for this; the complexity of understanding climate change (Anderson, 2012; Truelove & Parks, 2012), the lack of effective knowledge on how to mitigate personal behaviours that affect climate change (Frick, Kaiser, & Wilson, 2004) and also because of the difficulty in changing habitual climate change causing behaviours that are considered norms in Western societies (Stern, 2000). A key reason, touched upon by research on the impacts of climate change on mental health (Fritze, Blashki, Burke, & Wiseman, 2008), was the psychological and geographical distance between climatic extremes and climate events in Ireland. This research came about, in part, to try to understand if people at a geographical remove from the worst of the seemingly ubiquitous global environmental catastrophes could meaningfully learn about a topic in an empowering, non-threatening manner. Designing a study to understand if such an intervention could be undertaken in a manner that produced lasting behavioural and attitudinal effects followed naturally on from the decision to focus on learning about climate change as a topic.

While the researcher had strong intrinsic reasons to undertake research on this topic, they heeded the advice of applied psychologists (Barker, Pistrang, & Elliott, 2002) in balancing the personal with several extrinsic reasons for conducting the research. Undertaking the study as a means to fulfil a doctoral requirement provided the benefits of an institutional framework, chiefly the expert guidance of experienced supervisors and a peer support network. It also offered strict deadlines for planning, data gathering and writing as well as the impartial and objective assistance of academics on the research progression panels. This ensured that the research was guided by doctoral research standards while also allowing the researcher to develop their applied scientist research skills (Shapiro, 1985).

4.4 Rationale for methodological choices

4.4.1 Design

This research was identified as experimental in nature from the outset as it involved testing whether an exposure of interest, in this case the efficacy of a climate change education intervention developed by the researcher had an effect on an outcome of interest; student behaviours and attitudes over time (Mellis, 2020). Initially, a fully experimental study was planned for. This involved the use of two treatment conditions, a group exposed to an experimental intervention and another group acting as a control, who would only be exposed to the intervention upon completion of all measurements. This methodology would have allowed for an analysis of the variance between the two different groups over different time periods, thus supporting enhanced internal and external validity. It was realised, during the pilot stage of the intervention, that there were several threats to the study design that had been overlooked. The main threat to the reliability of the study was what had initially been considered a major strength; the use of comparator control groups from each school taking part in the intervention. The opportunity to take part in the intervention was seen as an exciting talking point by many in the intervention classes and it didn't take long for the students in the control group to hear about the climate change education modules being taught, and to ask their teachers to give them class time to learn about climate change and design posters on ways to mitigate it. This resulted in the activities of the experimental group acting as a confounding variable on the results coming from the control groups in the same schools, and potentially affecting the construct validity of the study and the reliability of any data collected from the group. Attempts were made both by the researcher and by academics within the affiliated university to source classes from additional schools to act as control groups. Despite many schools' interest in learning about climate change, school principals were reluctant to sign up to the programme at short notice and midway through

the academic year. This meant that a redesign of the experiment was needed following the pilot stage that took place in one school.

Following the setback with the control groups, one additional school was recruited bringing the number of participating schools up to 4, and possible classes to 8. The challenge was now about finding an adequate design that would allow for a study with high internal and external validity as well as reliability. A one-group repeated measures design was finally decided upon, primarily because it allowed for a direct estimate of change in relation to the studied variables over three points in time but also because many of the issues highlighted as threats to internal validity for this type of study could be controlled for (Price, Jhangiani, Chiang, Leighton, & Cuttler, 2017). One example of this is the threat that participating students might have learnt about climate change in geography or science class during the time period of the study, thus meaning any change in environmental behaviour couldn't entirely be ascribed to the effects of the study. This was controlled for by requesting that the teachers of classes who took part in the study agree to avoid formal instruction on the topic of climate change for the duration of the study.

An additional threat to the validity of the study was maturation or endogenous change, in which the participants would either grow into or grow out of a particular behaviour or attitude as a result of their natural cognitive or emotional development. A small-scale review on the effects of maturation on environmental behaviour was undertaken and included in Chapter 1 of the literature review to counter this. This review indicated that a significant major consideration related to the age of the students taking part in the study. Research highlights the bell-shaped developmental curve that children and adolescents experience from the age of 7 to 18 (Baierl, Kaiser, & Bogner, 2022; Otto, Evans, Moon, & Kaiser, 2019). Collectively, these

studies suggest a sharp rise in pro-environmental attitudes between the ages of 7-12, a static period between the ages of 12-14 before a drop between the ages of 16-18. This dip, attributed in different studies to a concurrent rise in self-enhancement values (Vechione, et al., 2019; Balunde, Perlaviciute, & Truskauskaite-Kuneviciene, 2020), changes in adolescents' locus of control (Boeve-de Pauw, Donche, & Van Petegem, 2011), or adolescent identity formation (Kaplan & Garner, 2017), was enough for the current study to aim to focus on the most stable period of biospheric environmental values; between the ages of 12 and 14 in order to limit the maturation threat. Bias within the participants was also considered through the use of a sample that included equal numbers of male and female students from urban and rural and DEIS and non-DEIS backgrounds. These measures, taken together with the results of a recent meta-analysis of CCE effects on adolescents, which suggested that the age at the time of intervention didn't impact knowledge, attitudes or behaviour, were seen as sufficient to address this factor. (van de Wetering, Leijten, Spitzer, & Thomaes, 2022).

One of the key strengths of the repeated measures design is that the sample size does not have to be as large as in an independent group design study in order to have the same statistical power or effect size (Minitab Statistics, 2015). Another of the strengths of the design of this study was the fact that it aimed to measure change in environmental attitudes and behaviour over three points in time. The majority of the studies highlighted either in the systematic review or discussed in the literature had used a pre-test-post-test design. While this type of design allowed for the measurement of any immediate effects of a given climate change education intervention, it did not reflect any longer-term impact that the preferred medium of teaching about climate change; formal classroom-based models, might have on attitudes and behaviour. While not as methodologically robust as a design using two or more groups, the use

of a repeated measures design did allow this study to identity what, if any gross effect can be attributed to CCE in the medium term (Rossi, Freeman, & Lipsey, 1999).

With this in mind, a statistical power analysis was run using the G Power programme version 3.1 (Faul, Erdfelder, Buchner, & Lang, 2007). A statistical power analysis identifies the likelihood that the proposed study will actually detect an effect that is present (Cohen, 1992). With an *alpha* (α) value of < .05 to identify false positives, a *beta (β)* value of .80 to identify false negatives, and a medium effect size of 0.25 the sample size needed was found to be 81students in total. Participating students were given either laptops or tablets and accessed a link to the survey through their Microsoft Teams account. The survey itself was forced choice in the sense that responses to each question had to be given before the student could move on to the next section. This had the advantage of ensuring all data sets were complete, without any missing variables during the data analysis aspect of the research.

Following on from the results of this research, investigation of the net effect of this particular CCE intervention in the short and medium term is now possible. Likewise, a comparison between the effect of this particular intervention and other interventions that take place outside of the classroom can be readily achieved now with a reworking of the design to compare the effects from this classroom-based intervention with a nature-based or more practical, ‘hands-on’ CCE intervention.

4.5 Role of different stakeholders

There were many stakeholders involved in this research and it was important to ensure that all stakeholders were provided with all relevant information. It was also important for each stakeholder to know their role in the experimental design and where other stakeholders fit in. For this reason, the protocol outlined in Figure 10 was developed. This ensured homogeneity of the intervention across schools while also allowing the researcher an easy way to explain both the stages of the research within the school environment as well as letting school staff know their responsibilities during a given stage.

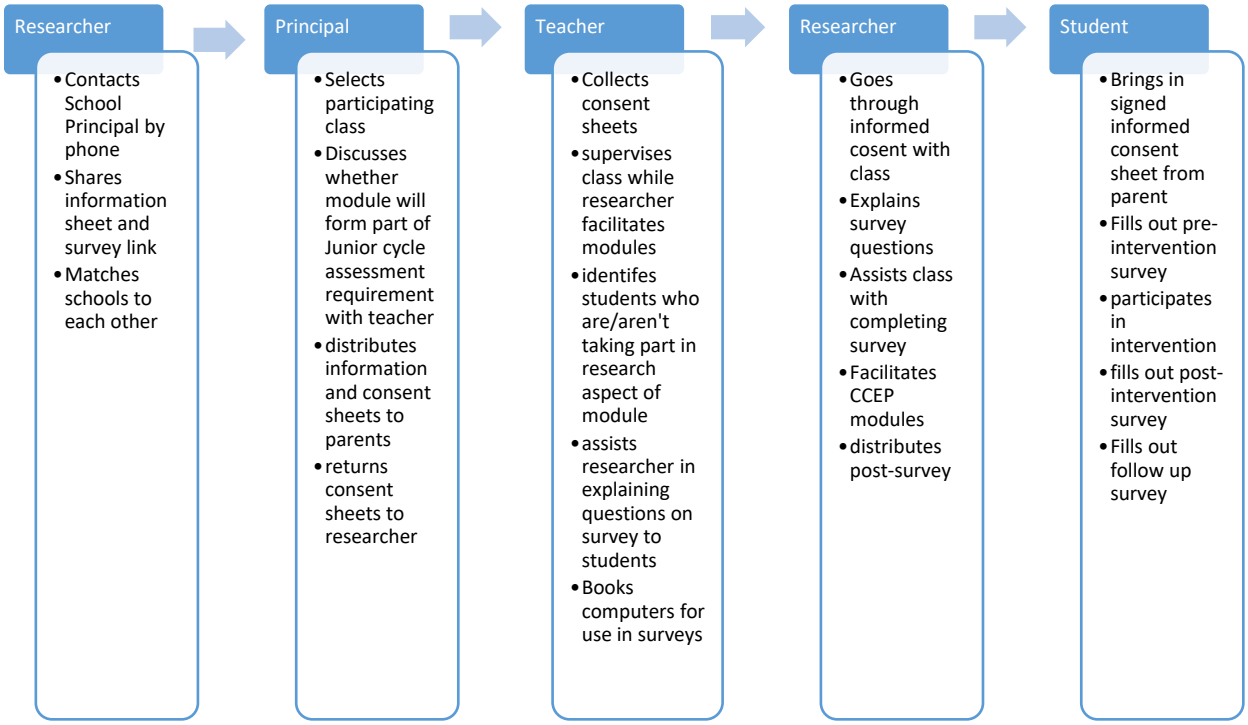


Figure 10:Roles and processes the intervention involved within the school setting

4.5.1 Measures

Undertaking a literature review of previous papers highlighted key trends in the development of measures used in relation to research on climate change education. Broadly speaking, this trend could be equated with the growth of the measurement of biospheric values on top of different self-reported attitudes and behaviours specific to climate change (Kaniušonytė, 2019; Valdez, Peterson, & Stevenson, 2018). Conceptually, many researchers assert that pro-climate behaviour (PCB) can be incorporated into pro-environmental behaviour given that climate is an integral part of the entire environmental system (Wu & Otsuka, 2021). Despite this, there have been several recent shifts towards a focus on climate change specific measurement in the last few years with a move towards the design of measures related specifically to climate change (Stevenson, Peterson, & Bondell, 2018). The reason for this is that while all climate change related activities have an impact on the environment, not all environmental actions have an impact on climate change mitigation or adaptation. The systematic review identified research that suggested that it is predominantly the sense of identity of a person rather than a particular attitude that determines environmental behaviour (Gatersleben, Murtagh, & Abrahamse, 2014) . The review also identified the mediating role that egotism plays in the development and enacting of environmental behaviours (Ignell, Davies, & Lundholm, 2019). For this reason, both specifically biospheric and egoistic values (Bouman, Steg, & Kiers, 2018) and a behaviour instrument that measured specific climate change mitigating behaviours were included among the survey instruments.

This study aimed to use measures developed specifically for adolescents and particular to climate change that had been found to be both reliable and valid through other research. The measures all aimed for high internal consistency, a form of reliability which measures how

closely related a set of items is as a group, through an examination of Cronbach's alpha scores (UCLA, 2016). Where possible univariate measures, or instruments that measured only one specific area were chosen. The instruments that were finally used included the following: hope for the future while considering climate change (Stevenson, Peterson, & Bondell, 2018), perception of risk and concern about climate change (Stevenson K. , Peterson, Bondell, & et al., 2014), biospheric and egoistic values (Bouman, Steg, & Kiers, 2018), self-reported participation in climate change mitigation behaviours (Stevenson & Peterson, 2015), and attitudes towards nature and the environment in general (Bogner & Wiseman, 2006). Further factor loadings, item level Cronbach's alpha scores and the test items themselves can be found in Appendix 12.

4.5.2 Analysis, interpretation, and dissemination

This section discusses the analysis, interpretation and dissemination of the data and findings from the research. The steps for undertaking a repeated measures analysis using the Statistical Package for the Social Sciences (SPSS, v28, IBM) were considered using two different SPSS manuals (Pallant, 2020) (Field, 2017). These manuals informed the design of the study as well as the step-by-step procedure for the analysis of data and understanding the SPSS output in the study. A data reduction exercise was carried out at this point to reduce the number of variables being considered. This involved the elimination of the warm- up questions about knowledge and two of the variables measuring hedonic and altruistic values. This was undertaken so as to be able to better focus the data analysis on the variables that the systemic review revealed to be more relevant to the research aims and hypotheses. As the data was from one group and based on Likert scale answers the risk of distorted data patterns was slim. Ensuring that the survey was forced choice also aided in ensuring that the frequency distribution

of responses was even with no outlying or irregular pattern on the scatter plots. Previous research had already ensured the inter-rater reliability for the measures was high and that the constructs that they were measuring were separate to each other. The main issue with the data involved four students rushing through their responses and giving the same response within each section of the survey. These responses were removed from the final data analysis.

After ensuring that the data met all of the assumptions of sphericity and normal distribution, both exploratory and confirmatory analyses were performed. Broad research questions such as whether a CCE intervention could impact students and to what extent were answered by undertaking an exploratory analysis of the data using a within-subject, general linear model repeated measures calculation. This was followed up with a series of paired samples t-tests for a confirmatory analysis of statistically significant differences over time within each of the variables. The results from this analysis informed the more focused hypotheses concerning the effect of a CCE intervention on biospheric and egoistic values and whether the CCE intervention could have a lasting effect at the six-month follow-on point.

As mentioned previously, this research was undertaken with the ambition to inform State policy on climate change education and curricular development, as well as to fulfil the requirements for professional doctorate training. To this end, dissemination of the research was a priority for the researcher. While the researcher intends to publish in peer-reviewed journals, efforts have already been made to disseminate results from both the systematic review and the empirical study, through presentations at the Psychological Society of Ireland's (PSI) Annual Conference and submissions to the National Council for Curriculum and Assessment (NCCA) on the direction the new climate change and sustainability course could take (see Appendix 12). Efforts were also made in co-founding a new special interest group on the Climate

Emergency within the PSI and to co-facilitate the drafting of a position statement that included the results of this research to be submitted to the NCCA's Climate Action and Sustainable Development Group. Meetings were arranged with the Chair of this group also to highlight the results of the research and to inform about different pathways for the curriculum in order to make it as effective as possible from a behavioural perspective. This has led to collaboration between the researcher and members of this group, in particular speaking at the inaugural Mary Robinson Climate Change Conference in July 2023.

4.6 Discussion

4.7 Strengths and limitations

The primary purpose of this study was to understand the short- and medium-term impact of a classroom-based CCE intervention on the values, attitudes, and behaviours of secondary school students in Ireland. A secondary aim was to explore the relationship between classroom-based interventions and biospheric values. These aims were considered important, both for the manner in which they could inform the Department of Education's efforts to develop a climate change curriculum, as well as to assist the academic field in understanding whether biospheric values could be impacted by climate change education within a classroom setting.

The primary strength of this study is also one of its characteristic features – the inclusion of a follow up survey undertaken at the 6-month period. It is well documented that one of the best ways to increase validity and reduce bias in research studies is to carry out follow-up research to determine how long the effects of the intervention might possible last. A limitation of repeated measures research is that it is prone to higher attrition rates, known as subject attrition (Barry, 2005). This can cause bias in a study, where those who drop out might have unique characteristics different to the remaining sample, which in turn can affect the validity of the

study (Boys, et al., 2003). A higher attrition rate was planned for in the current study by adding an extra, fifth class to the intervention. This brought the sample size up to 98 in total which meant that even after subject attrition, the final sample size was still above the threshold needed for an adequate effect size. This did not negate the possibility that the 16% of students who failed to complete all three measures had similar characteristics different to the rest of the sample. An examination of the reasons for the attrition, laid out in Table 9 suggests that there isn't any one unifying factor that the participants had in common.

Table 9: Causes of participant attrition.

Reason	# students impacted	# schools impacted
Camogie match	3	1
Football match	4	2
Sickness/ general absence	7	4
Suspension	1	1
Didn't want to participate	1	1

A number of study limitations are worth noting. One significant factor was the absence of a control group. The deletion of the control groups from the experiment had not been planned for. Therefore, the results from the experimental group could not be referenced or compared to other groups. The absence of a control group does increase the likelihood that the change identified through this research might have been due to external factors (Barker, Pistrang, & Elliott, 2002). While the use of participants from a range of schools does mitigate this limitation somewhat, a comparison of the results of each experimental class with the control class from the same school could have enhanced internal validity (Thomas, 2013).

The intervention sessions in this study were facilitated solely by the researcher. Initially, contact was made with a group of secondary school teachers within a sustainability network who had provisionally agreed to take part in the research. A research proposal to have 15 secondary school teachers practice the intervention with a further 15 as a control was drawn up. Using other teachers to teach the material was seen as a drawback to the study, as it could potentially affect the construct validity of the study insomuch as the quality of teaching can vary as well as the fact that teachers can potentially coach students to respond in a particular way (Appelbaum, et al., 2019). The fact that the participating teachers were all part of a sustainability network also meant that there was a strong likelihood that they had already included classroom instruction on climate change. For these reasons it was decided that only one person should deliver the intervention across all schools. This would ensure consistency of delivery across interventions and avoid any issues related to coaching students on answers. On the other hand, this intervention delivery choice did threaten the reliability of the experiment in a number of ways in relation to the Deliverer effect or what is also known as Experimenter bias (Webster & Sell, 2014). Ideally, the experimenter would be blind to the condition that is being run in order to reduce experimenter bias caused by subconscious cueing or coaching of participants (Kuipers & Hysom, 2014). The principal means of reducing Experimenter bias was through the use of anonymous and previously validated measures for the survey, meaning that the researcher had no part in the design of the survey questions. The fact that the schools themselves choose which classes would participate in the CCE intervention also added a degree of random sampling to the population selection. Furthermore, the researcher made clear his assumptions and the theoretical framework through which the research was undertaken from the start. This, together with a well-designed protocol explicitly outlining data collection and analysis can be taken as assisting in

reducing bias (Smith & Noble, 2014). Reflexivity was also encouraged through discussions with research supervisors and an independent check of the data by the supervisor. One method put into practice to reduce the deliverer effect was to minimise contact between the researcher and the students at the times that they were filling out the surveys. Prior to the commencement of the intervention the survey was explained to the class teacher, together with issues that might arise in relation to it, such as providing a unique 4-digit identification code. After an initial information sharing session, the researcher moved to the back of the class away from the viewpoint of the students. The researcher would then only get involved if the teacher was unable to provide the necessary level of assistance. It is hoped that any future research into climate change interventions in secondary school would involve the participation of a team of researchers in which data collection and analysis would be undertaken independently and at a remove from the researcher conducting the climate change education intervention.

A further issue in the study involved the use of a measure which tested self-reported behaviours only. While some papers have identified real-world methods to test for climate change behaviour following an intervention (Arya & Maul, 2016) (Goeschl & Perino, 2012) these are generally specific to one area, such as recycling or the willingness to pay taxes to offset carbon. Another issue is the fact that there can sometimes be discrepancies between self-reported practice of behaviours and actual behavioural practice (Spitzer & Weber, 2019). This can be due to social desirability bias, in which participants give the answer that they think is the most socially acceptable or simply because the participant is unsure of what is being asked of them or has limited insight into their own behaviour (McDonald, 2008). These issues can affect construct validity or the idea that the surveys are accurately measuring the theoretical constructs that they set out to measure. In order to mitigate this weakness, the questionnaire approach might have

been combined with other methods. While this was not undertaken in this particular study, it does inform a recommendation for any follow up study.

While many limitations were identified for this study it is important to remember that most of these weaknesses were either controlled for, or else the study was adapted to ameliorate for them. Consequently, the external validity of the study remains high, in that the findings of the study can be generalised beyond the immediate context, based on similar findings from each of the five participating schools. It should be noted that constructive or operational replication will be needed in order to concretely test this (Barker, Pistrang, & Elliott, 2002).

4.8 Ethical issues within the study

Ethical principles concern the protection of the rights, dignity and welfare of all stakeholders involved in a study (Barker, Pistrang, & Elliott, 2002). Acting ethically as a researcher involves weighing up the potential risks of a piece of research with the benefits it might bring, respecting people's rights and dignity, acting responsibly and with integrity, and conducting your research in a just manner (Price, Jhangiani, Chiang, Leighton, & Cuttler, 2017).The current study considered all ethical issues in light of the Psychological Society of Ireland's (PSI) Code of Ethics (Psychological Society of Ireland, 2019) and the Data Protection Act (2018). Similarly, the study, its design, sample, and data collection methods all had to be approved prior to commencement by the ethics committee of the institution the research was taking place through.

4.8.1 Working with a vulnerable population

Perhaps the most important ethical issues involved working with young people under the age of 18. A number of safeguarding actions were put in place to ensure that participants were protected. This included ensuring that all intervention and research activities took place on the

school premises, during school hours and with school staff members present at all times. Another important issue involved the fact that climate change can be an anxiety causing topic for some young people (Clayton, 2020; Clayton & Karazsia, 2020). Research suggests that heightened fear and worry about climate change is exhibited more often amongst highly problem-focused adolescents and that meaning-focused adolescents demonstrate more optimism for the future, while still taking climate change concerns into consideration (Ojala, 2012i 2012ii; 2013). The current research intervention was designed to be psycho-educational in nature and is partly aimed at assisting students to develop their own coping strategies in relation to climate change by understanding the science, the causes and the solutions at individual, school, and community-based levels. The intervention was designed to move students away from problem-focused perspectives on climate change, and to impart a positive and meaningful perspective on the role that students can play. As such, the design of the study incorporated the goal of reducing any climate change anxiety already present as per climate change coping models (Ojala, 2012).

4.8.2 Informed consent

The PSI's Code of Ethics (2019) makes clear the importance of obtaining informed consent from both adults and children. The current study sought informed consent from parents first using an information sheet that detailed information about the research, the doctoral course of study, the purpose and nature of the research, confidentiality, anonymity and the right to withdraw from the study (Appendix B). Informed consent was also obtained from students using an information sheet that followed the Universal Design for Learning (UDL) principles (Hall & Murray, 2010) (Appendix C). The purpose of the research, together with the assent form, were read out to each participating class at the commencement of the intervention. Participants were asked as a group and then individually just prior to the pre-test measure whether they had any

questions or concerns about the research. It was also explained to students, both before and during the survey, that participation in the survey was voluntary, and that any student who wanted to withdraw could do so at any time.

4.8.3 Confidentiality

The PSI's Code of Ethics (2019) also makes clear the responsibility of the researcher to limit the collection of information to that which is relevant to the research. The Code of Ethics also details the importance of limiting access to and correctly storing information that is personally identifiable. For the purposes of this research the issues of confidentiality and anonymity were explicitly addressed throughout, both on the information and informed consent sheets. The names of class teachers and students were collected initially. However, each student self-assigned a four-digit number based on digits in their parent's telephone numbers which was then used to link pre and post-tests. As soon as the data was downloaded onto the researcher's computer all identifying features were deleted and the 4-digit number formed the sole basis of each student's identifier.

4.9 Implications of the research for the field of psychology

Implications from the results of this study can be categorised into three particular areas; implications for the field of psychology, implications related to education and curriculum development and implications for future research.

This research contributes to the current psychological literature concerning the efficacy of formal, structured, classroom-based, climate change education in changing the knowledge levels, behaviour, attitude, and values of secondary age students in relation to climate change. Several recent research papers appear to validate a new model of adolescent climate change behaviour that considers student's affect when learning about the topic (Stevenson, Peterson, &

Bondell, 2018; Deisenrieder, Kubisch, Keller, & Stötter, 2020; Hu & Chen, 2016) (see Figure 11). The current study supports this model insomuch as increases in knowledge, hope and concern resulted in concurrent increases in self-reported behaviours in the short term. This highlights the importance of consideration of the affective dimension during climate change curricular development. This finding is also relevant to our understanding of how adolescents can productively cope with understanding the effects of climate change on their lives. Rather than teach climate change from an emotion-focused perspective, or from a purely scientific perspective, it is important to create accurate knowledge and a particular affect in order to develop a pattern or meaning focused coping in relation to climate change (Ojala, 2012i; 2012ii).

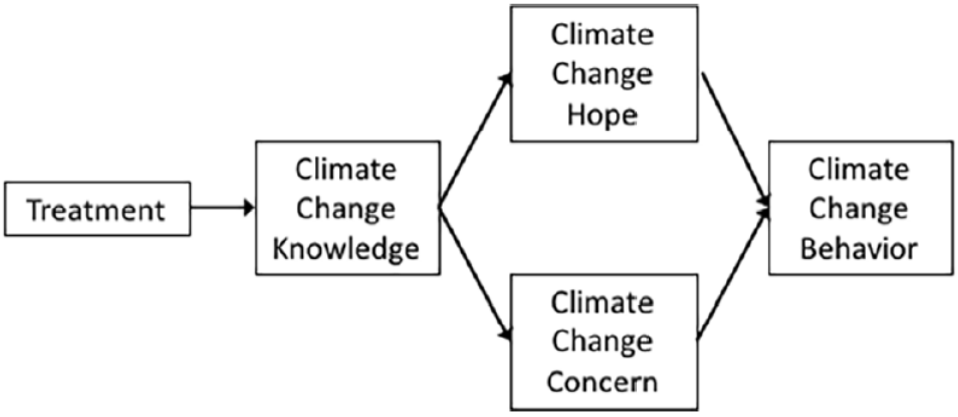


Figure 11: Stevenson, Peterson & Bondell's (2018) model of adolescent climate change behaviour

The systematic review in chapter 1 highlighted that over 70% of the included studies reported behavioural changes as a result of participation in a climate change education intervention. Other, large scale meta-analyses of the effects of environmental education also support this outcome, suggesting that self-reported pro-environmental behaviour increases

through both classroom-based and nature-based education programmes (van de Wetering, Leijten, Spitzer, & Thomaes, 2022; Zelezny, 1999). None of the reported studies incorporated longitudinal data however, as the follow up data collection was generally halted after the post-intervention survey had been undertaken. While results from the current study support the efficacy of CCE interventions in relation to short term behavioural change, they also suggest decreases in environmental knowledge, attitude, and behaviours within six months without reinforcement of the CCE material. The inclusion of this follow-up measure highlights a key issue in relation to the design of many of the studies examining the effects of classroom-based climate change education.

The current study also adds to the body of work related to the influence of values within the New Environmental Paradigm (Bernstein & Szuster, 2019). Values can be conceptualised at both the individual and group level (Bernstein & Szuster, 2019). The results of this study focused solely on the individual level. If individual values can be defined as the "internalised social representations or moral beliefs that people appeal to as the ultimate rationale for their actions" (Oyserman, 2015, p. 4) then, from the results of the current study, biospheric values that increase adolescents' consideration for the environment and environmental decision making can be altered through a CCE intervention. However, without further exposure to CCE material, or perhaps, a structured environment in which to discuss environmental issues, these values lose precedence in adolescents moral belief system and, presumably in the age-groups collective identity, which in turn determines the actions that make up the groups social life (Oyserman, 2015).

There is ongoing debate concerning the efficacy of CCE for different adolescent age groups. Some theorists suggest that pro-environmental values are at their weakest during middle

and late adolescence, with other self-enhancement and egoistic values coming to the fore (Otto, Moon, & Kaiser, 2019; Balunde, Perlaviciute, & Truskauskaite-Kuneviciene, 2020; Vechione, et al., 2019; Ignell, Davies, & Lundholm, 2019). Other theorists suggest that adolescents have developed a sense of self-identity by middle adolescence, and that this identity also includes a biospheric identify mediated by an emotional affinity for nature and a sense of morality around the preservation of natural environments (Gatersleben, Murtagh, & Abrahamse, 2014). The current research suggests that CCE is effective in increasing knowledge about climate change among adolescents in early and middle adolescence. Similarly, students within this age group are capable of forming new environmental attitudes and behaviours and adopting new biospheric values as a result of participation in climate change interventions. Again, the six month follow up results suggest that these values, attitudes and behaviours will decrease after the initial rise unless further climate change related activities occur. In terms of different values systems, previous research also suggests that the degree to which an egotistical, as opposed to biospheric, identity is present can act as a moderator on the number and type of pro-environmental behaviours carried out (Ignell, Davies, & Lundholm, 2019). The current research clearly shows that as the number of self-reported behaviours related to climate change increases, the sense of identity associated with egotistical values decreases, in line with other research (Ignell, Davies, & Lundholm, 2019). Interestingly, it also appears that participation in the CCE intervention can act as a moderator on the sense of identity associated with egotistical values. In the current study, as environmental knowledge, attitudes, and behaviours increased, there was a concurrent drop in egotistical values. Also of interest is the fact that egotistical values remained at a statistically significant lower level even after the results of the six-month follow up were collected.

4.10 Implications of the research for educational psychology, schools, and services

A primary benefit of this research is in how it draws a link between climate change and psychology, in particular educational psychology. As far back as 2009, the Lancet Journal referred to the issue of climate change as "the biggest threat to global health – and mental health in particular- of the 21st century" (Costello, et al., 2009, p. 1694). As awareness of the potential negative impacts of climate change increased many national psychological services or representative bodies have released reports on the psychological impact of climate change, most notably the American Psychological Association in 2017 (APA, 2017). The APA and other bodies such as the British Psychological Society have also released special reports and held fora on the topic (Clayton, Manning, Speiser, & Hill, 2021; Wainwright & Mitchell, 2020) which explicitly consider the importance of incorporating planetary wellbeing into educational curricula at all levels. At a national level in Ireland efforts have been made within professional bodies and universities to bring climate change mitigation and adaptation to the forefront of public consciousness. The work of academics in Mary Immaculate College, Limerick on teaching climate change at primary school level (Dolan, 2022) and the establishment of a special interest group about the climate emergency and sustainability within the Psychological Society of Ireland are two examples of this. Despite these efforts, attempts to understand the intersectionality of climate change in Ireland within the fields of education and psychology have been limited. The current study can act as an example of the role that educational psychology can potentially play in developing materials that assist students in producing their own meaningful interpretations of what climate change means to them and their communities. It can also assist students in

considering the meaningful roles that they and their communities can play in mitigating for the effects and preparing for the consequences of climate change.

The National Council for Curriculum and Assessment (NCCA) is currently working with learners, teachers, parents, and other stakeholders to develop a new subject entitled *Climate Action and Sustainable Development* (NCCA, 2022). As mentioned earlier, the role that psychology can play in informing curricular developments about climate change has been largely unexplored at a national level in Ireland. Results from the systematic review and empirical paper of the current study were used as the basis for the submission to the NCCA on how psychology can inform this process (see Appendix 12 for submission). A report by the NCCA after the consultative stage included many of the key issues raised in the submission, including, the role of experts within the process, the importance of student-centred learning and the importance of the environment in which the CCE takes place (NCCA, 2022). The completion of this study has even further implications for the development of this curriculum. This includes the importance of exploring non-classroom-based strategies in relation to learning and acting upon climate change. This is particularly important if the curricular aims involve going further than the mere acquisition of knowledge about the causes and effects of climate change and towards the relationship between the causes of climate change and the lifestyle and consumer choices of those who inhabit the Western world.

4.11 Implications for future research

The current research highlights the effects of classroom-based learning about climate change in the short-term. The results generally support findings from other, similar studies aimed at measuring the practical effectiveness of climate change education. Typically, these studies demonstrate the importance of providing students with a space to learn about

climate change using scientific data and freely express their views on climate change under the guidance of an outside expert or trained facilitator (Arya & Maul, 2016). What is not as well-known is how well such approaches work in terms of their effect on values, attitudes and behaviour when compared to non-classroom-based forms of learning. Undertaking research in this area is more important than ever as the Department of Education in Ireland begins to consider how climate change can be incorporated into the curriculum. It is even more important when we consider the limitations in terms of knowledge, behaviour and attitudinal regression that occur over time in relation to classroom-based climate change education. This study also recognises the limitations of self-reported responses in relation to climate change behaviours and identifies the need for research that uses other approaches to determine the effects of CCE on behaviour, and the extent to which CCE can both involve and increase the agency of secondary level students in the topic of climate change.

4.12 Impact Statement

Any research on climate change, including the current study, is invariably undertaken in order to better understand the impact that manmade climate change will have on our societies. Such research often examines some of the myriad ways, both small and large, in which the current generation can lessen the impact that the GHG emissions caused by their way of life might have on future generations. The intervention in this piece of research aims to do this by increasing the awareness amongst secondary level students about how the patterns of consumption that they engage in can be changed. It also aims to engage students in discussions about the positive and negative effects that their consumption patterns have on themselves, their families, and others. At the very least this will begin a discussion within the school community that, through this intervention, can be informed by relevant empirical evidence about the issue.

The intervention can also provide a space for students, together with their teachers, to start considering ways in which they can act as a class or school to get involved. A class in one of the schools involved established a green committee to invite different stakeholders in to discuss the issue of climate change. Another school started a letter writing and tree-planting campaign after taking part in the intervention. It must be pointed out that climate change interventions impact the adults in the room, in this case the teachers and school support staff, as much as the students for whom the intervention is designed. Having teachers on board no doubt helps students navigate through the school bureaucracy not to mention the real-world problems associated with organising collective actions to mitigate against climate change.

The other major impact from this piece of research has been the connections made with other psychologists and academics concerned with climate change in the region. These connections have not only informed the research, but they have also allowed the researcher to take part in several initiatives, including the establishment of a special interest group within the Psychological Society of Ireland about climate change[2] as well as taking part in Sustainable School Initiatives[3] and engaging with the NCCA's climate change advisory body, both formally and informally. All of these meetings have helped confirm the findings from this piece of research while also linking in the findings with other science-based perspectives currently held by experts in the field. The area that this research contributes to is a very active and constantly changing field, both as our understanding of climate change evolves as well as through policy

[2] https://www.psychologicalsociety.ie/groups/Special-Interest-Group-for-Addressing-Climate-and-Environmental-Emergency

[3] Irish Schools Sustainability Network - https://www.issn.ie/

changes at national and international level. It is hoped that this study has contributed in some small part to continuing this positive change.

5 References

Nongqayi, L., Risenga, I., & Dukhan, S. (2022). Youth's knowledge and awareness of human contribution to climate change: the influence of social and cultural contexts within a developing country. *Educational and Development Psychologist, 39*, 44-57. Retrieved from 10.1080/20590776.2022.2050461

Agirreazkuenaga, L., & Martinez, P. (2021). Secondary school student's perception, positioning and insight on education for sustainabilitity. *International research in geographical and environmental education, 30*, 218-237. Retrieved from https://doi.org/10.1080/10382046.2021.1877952

Ajzen, I. (1991). The theory of planned behaviour. *Organizational Behavior and Human Decision Process, 50*(2), 179-211. doi:https://doi.org/10.1016/0749-5978(91)90020-T

Alexander, R., & Poyyamoli, G. (2017). Climate change education for school students-activity-based teaching learning approach to create knowledge, attitudes skills and behavioural change. *International Journal of Global Warming, 12*(3-4), 431-447. doi:10.1504/IJGW.2017.10005894

Ali Khan, N., Karpudewan, M., & Annamalai, N. (2021). Moving beyond the one size fits all model in describing the climate conserving behaviors of Malaysian scondary students. *Sustainability, 13*(18), 1-20. Retrieved from https://dx.doi.org/10.3390/su13010018

ALLEA. (2020). *A snapshot of climate change education initiatives in Europe: Some initial findings and implications for future climate change education research.* Berlin: ALLEA. doi:10.26356/climateeducation

An Taisce. (2016). *Green-schools programme.* Dublin: An Taisce Environmental Education Unit. Retrieved October 5, 2022, from https://greenschoolsireland.org/wp-content/uploads/2016/09/General-Handbook.pdf

Anderson, A. (2013). Climate change education for mitigation and adaptation. *Journal of Education for Sustainable Development, 6*(2), 191-206. doi:10.1177/0973408212475199

APA. (2017). *Mental health and our changing climate.* Washington DC: American Psychological Association.

Appelbaum, N., Santen, S., Vota, S., Wingfield, L., Sabo, R., & Yaghmour, N. (2019). Threats to reliability and validity with resident welness surveying efforts. *Journal of Graduate Medical Education, 11*(5), 543-549. doi:10.4300/JGME-D-19-00216.1

Ardoin, N., Bowers, A., Roth, N., & Holthuis, N. (2018). Environmental education and K-12 outcomes: A review and analysis of research. *The Journal of Environmental Education, 49*(1), 1-17. doi:https://doi.org/10.1080/00958964.2017.1366155

Armson, R. (2011). Drawing Rich Pictures. In R. Armson, *Growing wings on the way: Systems thinking for messy situations* (pp. 57-77). Axminster: Triarchypress.

Arya, D., & Maul, A. (2016). The building of knowledge, language, and decision-making about climate change science: a cross-national program for secondary students. *International Journal of Science Education, 38*(6), 885-904. doi:10.1080/09500693.2016.1170227

Axelrod, L., & Lehman, D. (1993). Responding to environmental concern: What factors guide individual action? *Journal of Environmental Psychology, 13*(2), 149-159. doi:10.1016/S0272-4944(05)80147-1

Azjen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behaviour.* Englewood Cliffs: Prentice-Hall.

Baierl, T. M., Kaiser, F. G., & Bogner, F. X. (2022). The supportive role of environmental attitude for learning about environmental issues. *Journal of Environmental Psychology, 81*, 1-11. doi:10.1016/j.jenvp.2022.101799

Balgopal, M., Klein, J., Brown, C., Sample McMeeking, L., Morgan, J., & Marshall Frasier, w. (2014). Linking biophysical, socioeconomic, and political effects of climate change on agro-ecosystems. *Journal of Geoscience Education, 62*(3), 343-353. Retrieved from https://www.proquest.com/docview/1564036917/fulltextPDF/F21593ECCDD8470FPQ/1?accountid=55804

Balunde, A., Perlaviciute, G., & Steg, L. (2019). The relationship between people's environmental considerations and pro-environmental behavior in Lithuania. *Frontiers in Psychology, 10*. doi:10.3389/fpsyg.2019.02319

Balunde, A., Perlaviciute, G., & Truskauskaite-Kuneviciene, I. (2020). Sustainability in Youth: Environmental Considerations in Adolescence and Their Relationship to Pro-environmental Behavior. *Frontiers in Psychology*. Retrieved from https://doi.org/10.3389/fpsyg.2020.582920

Bamberg, S., & Moser, G. (2007). Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour. *Journal of Environmental Psychology, 27*(1), 14-25. doi:10.1016/j.jenvp.2006.12.002

Barker, C., Pistrang, N., & Elliott, R. (2002). *Research methods in clinical psychology: An introduction for students and practitioners* (2nd ed.). Chicester: John Wiley & Sons.

Barry, A. (2005). How attrition impacts the internal and external validity of longitudinal research. *Journal of School Health, 75*(7), 267-270. doi:10.1111/j.1746-1561.2005.00035.x

Barton, H., & Grant, M. (2006). A health map for the local human habitat. *The Journal of the Royal Society for the Promotion of Health, 126*(6), 252-261. doi:doi.org/10.1177%2F1466424006070466

Berglund, T., Gericke, N., & Change-Rundgren, S. (2014). The implementation of education for sustainable development in Sweden: investigating the sustainability consciousness among upper secondary students. *Research in Science and Technological Education, 32*(3), 318-339. doi:10.1080/02635143.2014.944493

Bergman, B. G. (2016). Assessing impacts of locally designed environmental education projects on students' environmental attitudes, awareness, and intention to act. *Environmental Education Research, 22*(4), 480-503. doi:https://doi.org/10.1080/13504622.2014.999225

Bernstein, J., & Szuster, B. (2019). The new environmental paradigm scale: Reassessing the operationalization of contemporary environmentalism. *The Journal of Environmental Education, 50*(2), 73-83. doi:10.1080/00958964.2018.1512946

Bodzin, A., & Qiong, F. (2014). The effectiveness of the geospatial curriculum approach on urban middle level students' climate change understandings. *Journal of Science Education & Technology, 23*(4), 575-590. doi:10.1007/s10956-013-9478-0

Boeve-de Pauw, J., Donche, V., & Van Petegem, P. (2011). Adolescents' environmental worldview and personality: An explorative study. *Journal of Environmental Psychology, 31*, 109-117. doi:10.1016/j.jenvp.2010.05.003

Bofferding, L., & Kloser, M. (2015). Middle and high school students' conceptions of climate change mitigation and adaptation strategies. *Environmental Education Research, 21*(2), 275-294. doi:10.1080/13504622.2014.888401

Bogner, F., & Wiseman, M. (2006). Adolescent's attitudes towards nature and environment. *Environmentalist, 26*, 231-237. doi:https://doi.org/10.1007/s10669-006-8660-9

Boland, L. (2022, January 29). *'Dismal' and 'inadequate' climate education must be tackled, students and teachers say.* Retrieved from thejournal.ie: https://www.thejournal.ie/climate-education-strategy-schools-5667296-Jan2022/

Bouman, T., Steg, L., & Kiers, H. (2018). Measuring Values in Environmental Research: A Test of an Environmental Portrait Value Questionnaire. *Personality and Social Psychology, 9*, 1-15. doi:https://doi.org/10.3389/fpsyg.2018.00564

Bourdieu, P. (1977). *Outline of a theory of practice.* Cambridge: Cambridge University Press.

Boyes, E., & Stanisstreet, M. (2011). Environmental education for behaviour change: Which actions should be targeted? *International Journal of Science Education, 34*(12), 1591-1614. doi:10.1080/09500693.2011.584079

Boyes, E., Skamp, K., & Stanisstreet, M. (2009). Australian secondary students' views about global warming: beliefs about actions, and willingness to act. *Research in Science Education, 39*, 661-680. doi:https://doi.org/10.1007/s11165-008-9098-5

Boys, A., Marsden, J., Stillwell, G., Hatchings, K., Griffiths, P., & Farrell, M. (2003). Minimising respondent attrition in longitudinal research: practical implications from a cohort study of adolescent drinking. *Journal of Adolescence, 26*(3), 363-373. doi:10.1016/s0140-1971(03)00011-3

Bracken, S. (2010). Discussing the importance of ontology and epistemology awareness in practitioner research. *Worcester Journal of Learning and Teaching, 4*, 1-9. Retrieved from https://eprints.worc.ac.uk/843/1/FinalSBrackenPractitionerResearch.pdf

Bratman, G. N., Olvera-Alvarez, H., & Gross, J. J. (2021). The affective benefits of nature exposure. *Social and Personality Psychology Compass, 15*(8). doi:https://doi-org.libraryproxy.mic.ul.ie/10.1111/spc3.12630

Brumann, S., Ohl, U., & Schulz, J. (2022). Inquiry-based learning on climate change in upper secondary education: A design based approach. *Sustainability, 14*, 1-29. doi:10.3390/su14063544

Burgland, T., Gericke, N., & Chang-Rundgren, S. (2014). The implementation of education for sustainable development in Sweden: investigating the sustainability consciousness among upper secondary students. *Research in Science & Technological Education, 32*(3), 318-339. doi:https://doi-org.libraryproxy.mic.ul.ie/10.1080/02635143.2014.944493

Carr, A. (2016). *The handbook of clinical and adolescent psychology: A contextual approach* (3rd ed.). London: Routledge.

Cebrian, G., Pascual, D., & Moraleda, A. (2019). Perception of sustainability competencies amongst Spanish pre-service secondary school teachers. *International Journal of Sustainability in Higher Education, 20*(7), 1171-1190. doi:http://dx.doi.org/10.1108/IJSHE-10-2018-0168

Checkland, P., & Poulter, J. (2006). *Learning for Action: A short definitive account of soft systems methodology and its use for practitioners, teachers and students.* Chichester: John Wiley and Sons Ltd.

Chen, K. H. (2019). Transforming environmental values for a younger generation in Taiwan: A participatory action approach to curriculum design. *Journal of Future Studies, 23*(4), 79-96. doi:10.6531/JFS.201906_23(4).0008

Choy, E. (2014, August). *Body Earth Metaphor Workshop.* Retrieved from Movement Generation: https://movementgeneration.org/wp-content/uploads/2014/08/Body-Earth-Metaphor-2014.pdf

Clayton, S., Manning, C., Speiser, M., & Hill, A. (2021). *Mental health and out changing climate: impacts, inequities, responses* (2nd ed.). Washington DC: American Psychological Association and ecoAmerica. Retrieved from https://www.apa.org/news/press/releases/mental-health-climate-change.pdf

Cohen, J. (1992). A power primer. *Psychological Bulletin*, 1304-1312. doi:10.1037//0033-2909.112.1.155

Collado, S., Staats, H., & Corraliza, J. (2013). Experiencing nature in children's summer camps: Affective, cognitive and behavioral consequences. *Journal of Environmental Psychology, 33*, 37-44. Retrieved from https://doi.org/10.1016/j.jenvp.2012.08.002

Cordero, E., Centeno, D., & Todd, A. M. (2020). The role of climate change education on individual lifetime carbon emissions. *PloS ONE, 15*(2), 1-23. doi:10.1371/journal.pone.0206266

Corral-Verdugo, V. (1997). Dul 'realities of conservation behaviour: Self reports versus observations of re-use and recycling behaviour. *Journal of Environmental Psychology, 17*, 135-145. Retrieved from https://doi.org/10.1006/jevp.1997.0048

Costello, A., Abbas, M., Allen, A., Ball, S., Bell, S., Bellamy, R., . . . Patterson, C. (2009). Managing the health effects of climate change. *The Lancet Commissions, 373*(9676), 1693-1733. doi:https://doi.org/10.1016/S0140-6736(09)60935-1

Crocetti, E., Rubini, M., Luyckx, K., & Meeus, W. (2007). Identity formation in early and middle adolescents from various ethnic groups: From three dimensions to five statuses. *journal of Youth and Adolescence, 37*, 983-996. doi:10.1007/s10964-007-9222-2

Crotty, M. (1998). *The foundations of social research: meaning and perspective in the research process.* London: Sage.

CSO. (2021). *Environmental Indicators in Ireland.* Retrieved from Central Statistics Office : https://www.cso.ie/en/releasesandpublications/ep/p-eii/environmentalindicatorsireland2021/mainfindings/

Damerell, P., Howe, C., & Milner-Gulland, E. J. (2013). Child-orientated environmental education influences adult knowledge and household behaviour. *Environmental Research, 8*(1), 1-8. Retrieved from 10.1088/1748-9326/8/1/015016

Davis, A., & Stroink, M. (2015). The relationship between systems thinking and the New Ecological Paradigm. *Systems Research and Behavioural Science, 33*(4), 575-586. Retrieved from https://doi-org.libraryproxy.mic.ul.ie/10.1002/sres.2371

Dawson, V. (2015). Western Australian high school students' understandings about the socioscientific issue of climate change. *International Journal of Science Education, 37*, 1024-1043. doi:https://doi-org.libraryproxy.mic.ul.ie/10.1080/09500693.2015.1015181

de Groot, J., & Steg, L. (2007). Value orientations to explain beliefs related to environmental significant behaviour: how to measure egoistic, alotruistic and biospheric value orientations. *Environmental Behaviour, 40*, 330-354. doi:10.1177/0013916506297831

deGroot, J., & Steg, L. (2007). General beliefs and the theory of planned behaviour: The role of environmental concerns in the TPB. *Journal of Applied Social Psychology, 37*(8), 1817-1836.

Deisenrieder, V., Kubisch, S., Keller, L., & Stötter, J. (2020). Bridging the action gap by democratizing climate change education-The case of k.i.d.Z.21 in the context of Fridays for Future. *Sustainability, 12*, 1-19. doi:10.3390/su12051748

Department of Education and Skills. (2016). *School self-evaluation guidelines 2016-2020.* Dublin: Department of Education and Skills. Retrieved from https://www.gov.ie/en/publication/5c47a7-school-self-evaluation-guidelines/

Department of the Environment, Climate and Communications. (2021, July). *Government approves landmark Climate Bill putting Ireland on the path to net-zero emissions by 2050.* Retrieved from gov.ie: https://www.gov.ie/en/press-release/22e97-government-approves-landmark-climate-bill-putting-ireland-on-the-path-to-net-zero-emissions-by-2050/

Dept of Communications, Climate Action and Environment. (2019). *Climate Action Plan.* Dublin: Government of Ireland. Retrieved from https://assets.gov.ie/25419/c97cdecddf8c49ab976e773d4e11e515.pdf

Dept of Education. (2022). *Looking at Our School 2022: A quality framework for post-primary schools.* Dublin: Department of Education. Retrieved from https://www.gov.ie/en/publication/b1bb3-looking-at-our-school-2022/

Dept of Education and Skills. (2014). *Education for Sustainability : The National Strategy on Education for Sustainable Development in Ireland, 2014-2020.* Dublin: Dept of Education and Skills. Retrieved from http://www.unesco.org/education/edurights/media/docs/a0b5b82b0e14b72030246935ad6a1bf914f158bc.pdf

Dept of the Environment, Climate and Communications. (2021). *Climate Action Plan 2021: Securing our Future.* Dublin: Government of Ireland, Department of the Environment, Climate and Communications. Retrieved July 11th , 2022, from https://assets.gov.ie/224574/be2fecb2-2fb7-450e-9f5f-24204c9c9fbf.pdf

DES. (2014). *The national strategy on education for sutainable development in Ireland, 2014-2020.* Dublin: Department of Education and Skills. Retrieved from file:///C:/Users/35387/Downloads/70926_7e8f9ccf9069441e960d7f32a38dc7b9.pdf

DES. (2015). *Framework for Junior Cycle.* Dublin: Ireland: Department of Education and Skills. Retrieved 18 10, 2022, from https://ncca.ie/media/3249/framework-for-junior-cycle-2015-en.pdf

Dhanapal, S., & Lim, C. (2013). A comparative study of the impacts and students' perceptions of indoor and outdoor learning in the science classroom. *Asia-Pacific Forum on Science*

Learning and Teaching, 14(2), 1-23. Retrieved from http://libraryproxy.mic.ul.ie/login?url=https://www.proquest.com/scholarly-journals/comparative-study-impacts-students-perceptions/docview/1955901936/se-2.

Dietz, T., Gardner, G., Gilligan, J., Stern, P., & Vandenbergh, M. (2009). Household actions can provide a behavioral wedge to rapidly reduce US carbon emissions. *PNAS, 106*(44), 18452-18456. doi:https://doi.org/10.1073/pnas.0908738106

Dolan, A. (2022). *Teaching climate change in primary schools.* Dublin: Routledge.

Duerden, M., & Witt, P. (2010). The impact of direct and indirect experiences on the development of environmental knowledge, attitudes, and behavior. *Journal of Environmental Psychology, 30*(4), 379-392. doi:10.1016/j.jenvp.2010.03.007

Dunlap, R. (2008). The New Environmental Paradigm Scale: From marginality to worldwide use. *Journal of Environmental Education, 40*(1), 3-18. doi:10.3200/JOEE.40.1.3-18

Dunlap, R., Van Liere, K., Mertig, A., & Jones, R. (2000). Measuring endorsement of the new ecological paradigm: A revised NEP scale. *Journal of Social Issues, 56*(3), 425-442. doi: https://doi.org/10.1111/0022-4537.00176

Duvall, J., & Zint, M. (2007). A review of research on the effectiveness of environmental education in promoting intergenerational learning. *The Journal of Environmental Education, 38*(4), 14-24. doi:10.3200/JOEE.38.4.14-24

ECO UNESCO. (2010). *Youth for the Future: Creating a sustainable world.* Dublin: ECO UNESCO. Retrieved from https://issuu.com/ecounesco/docs/youth_for_the_future_resource

Eggert, S., Nitsch, A., Boone, W., Nuckles, M., & Bogeholz, S. (2017). Supporting students learning and socioscientific reasoning about climate change- the effect of computer-based concept mapping scaffolds. *Research in Science Education, 47*, 137-159. doi:10.1007/s11165-015-9493-7

Environmental Protection Agency. (2019). *Where are Ireland's emissions coming from?* Retrieved from EPA: https://www.epa.ie/media/epa-2020/monitoring-amp-assessment/climate-change/Ireland%C3%A2%C2%80%C2%99s_GHG_emissions_sources_and_solutions.pdf

EPA. (2022, June). *Greenhouse gas emissions and projections - Key messages.* Retrieved from Environmental Protection Agency: https://www.epa.ie/our-services/monitoring--assessment/climate-change/ghg/key-messages/

EPA. (2022, June). *Latest Emissions Data.* Retrieved from Environmental Protection Agency: https://www.epa.ie/our-services/monitoring--assessment/climate-change/ghg/latest-emissions-data/

Farrand, P., Hussain, F., & Hennessy, E. (2002). The efficacy of the 'mind map' study technique. *Medical Education, 36,* 426-431. doi:10.1046/j.1365-2923.2002.01205.x

Faul, F., Erdfelder, E., Buchner, A., & Lang, A. (2007). G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*(2), 175-191. doi:10.3758/bf03193146

Fehr-Duda, H., & Fehr, E. (2016). Sustainability: Game human nature. *Nature, 530,* 413-415. doi:https://doi.org/10.1038/530413a

Feinstein, N., & Mach, K. (2019). Three roles for education in climate change adaptation. *Climate Policy,* 1469-3062. doi:https://doi.org/10.1080/14693062.2019.1701975

Field, A. (2017). *Discovering Statistics using IBM SPSS statistics* (5th ed.). London: Sage.

Flora, J. A., Saphir, M., Lappé, M., Roser-Renouf, C., Maibach, E., & Leiserowitz, A. (2014). Evaluation of a national high school entertainment education program: The Alliance for Climate Education. *Climatic Change, 127*(3-4), 419-434. doi:10.1007/s10584-014-1274-1

Frankel, S., Sellmann-Risse, D., & Basten, M. (2019). Fourth graders' connectedness to nature - Does cultural background matter? *Journal opf Environmental Psychology, 66,* 1-7. doi:https://doi.org/10.1016/j.jenvp.2019.101347

Frick, J., Kaiser, F., & Wilson, M. (2004). Environmental knowledge and conservation behaviour: Exploring prevalence and structure in a representative sample. *Personality and Individual differences, 37*(8), 1597-1613. doi:http://dx.doi.org/10.1016/j.paid.2004.02.015

Fritze, J., Blashki, G., Burke, S., & Wiseman, J. (2008). Hope, despair and transformation: Climate change and the promotion of mental health and wellbeing. *International journal of mental health systems, 2,* 1-13. doi:10.1186/1752-4458-2-13

Gallagher, K. (2008). *The Methodological Dilemma: Creative, critical, collaborative and post-positivist* . London: Rutledge.

Gatersleben, B., Murtagh, N., & Abrahamse, W. (2014). Values, identity and pro-environmental behaviour. *Contemporary Social Science, 9*, 374-392. doi:10.1080/21582041.2012.682086

Goeschl, T., & Perino, G. (2012). instrument choice and motivation: Evidence from a climate change experiment. *Environmental Resources Economics, 52*, 195-212. doi:10.1007/s10640-011-9524-4

Gottlieb, D., Vigoda-Gadot, E., & Haim, A. (2013). Encouraging ecological behaviors among students by using the ecological footprint as an educational tool: a quasi-experimental design in a public high school in the city of Haifa. *Environmental Education Research, 19*(6), 844-863. doi:10.1080/13504622.2013.768602

Gottlieb, D., Vigoda-Gadot, E., Haim, A., ., ,, & . (2013). Encouraging ecological behaviors among students by using the ecological footprint as an educational tool: a quasi-experimental design in a public high school in the city of Haifa. *Environmental Education Research, 19*(6), 844-863. doi:10.1080/13504622.2013.768602

Gough, D. (2007). Weight of Evidence: A framework for the appraisal of the quality and relvence of evidence. *Research Papers in Education, 22*(2), 213-228. doi:10.1080/02671520701296189

Government of Ireland. (2018). *Data Protection Act, 2018.* Retrieved from https://www.gov.ie/pdf/?file=https://assets.gov.ie/122558/49907c6f-a2e5-4c9e-8ee0-953315da668c.pdf#page=null

Government of Ireland. (2022). *2nd national strategy on education for sustainable development ESD to 2030.* Dublin: Govt of Ireland. Retrieved 10 13, 2022, from https://www.gov.ie/en/publication/02952d-national-strategy-on-education-for-sustainable-development-in-irelan/

Government of Ireland. (2022). *ESD to 2030: Implementation plan 2022-2026.* Dublin: Government of Ireland. Retrieved from https://www.gov.ie/en/publication/02952d-national-strategy-on-education-for-sustainable-development-in-irelan/

Gowdy, J. (2008). Behavioral economics and climate change policy. *Journal of Economic behavior and organisation, 68*(3-4), 632-644. doi:10.1016/j.jebo.2008.06.011

Griffin, P., Heede, R., & van Der Vlugt, I. (2017). *The Carbon Majors database.* Brussels: Carbon Disclosure Project. Retrieved from Sustainability for all: https://cdn.cdp.net/cdp-production/cms/reports/documents/000/002/327/original/Carbon-Majors-Report-2017.pdf?1501833772

Grønhøj, A., & Thøgersen, J. (2009). Like father, like son? Intergenerational transmission of values, attitudes, and behaviours in the environmental domain. *Journal of Environmental Psychology, 29*(4), 414-421. doi:10.1016/j.jenvp.2009.05.002

Grønhøj, A., & Thøgersen, J. (2012). Action speaks louder than words: The effect of personal attitudes and family norms on adolescents' pro-environmental behaviour. *Journal of Economic Psychology, 33*(1), 292-302. doi:10.1016/j.joep.2011.10.001

Hall, T., & Murray, B. (2010). *Universal Design for Learning.* Washington: TEAL. Retrieved from https://lincs.ed.gov/sites/default/files/2_TEAL_UDL.pdf

Han, H., Hsu, J., & Chwen, S. (2010). Application of the theory of planned behaviour to green hotel choice: Testing the effect of environmentally friendly activities. *Tourism Management, 31*(3), 325-334. doi:https://doi.org/10.1016/j.tourman.2009.03.013

Heberlein, T. (2012). *Navigating environmental attitudes.* New York: Oxford University Press.

Helm, D. (2011). Sustainable consumption, climate change and future generations. *Royal Institute of Philosophy, 69*, 235-252. doi: https://doi.org/10.1017/S1358246111000294

Hermans, M., & Korhonen, J. (2007). Ninth graders and climate change: Attitudes towards consequences, views on mitigation, and predictors of willingness to act. *International Research in Geographical and Environmental Education, 26*(3), 223-239. doi:https://doi.org/10.1080/10382046.2017.1330035

Hertwich, E. (2005). Life cycle approaches to sustainable consumption: A critical review. *Environmental science and technology, 39*(13), 4673-4684. doi:https://doi.org/10.1021/es0497375

Hertwich, E., & Peters, G. (2009). Carbon footprint of nations: A global, trade-linked analysis. *Environmental Science and Technology, 43*(16), 6414-6420. doi:https://doi.org/10.1021/es803496a

Hesse-Biber, C. (2019). The role of hybrid methodologies in understanding complex environmental issues and promoting social justice. *International Journal for Transformative Research, 6*(1), 20-26. doi:https://doi.org/10.1515/ijtr-2019-0004

Hicks, D. (2019). Education and Climate Change. In C. Simon, & S. Ward, *A student's guide to education studies.* London: Routledge.

Hines, J. (1987). Analysis and synthesis of research on responsible environmental behaviour: A meta-analysis. *Journal of Environmental Education, 18*(2), 1-8.

Hines, J., Hungerford, H., & Tomera, A. (1987). Analysis and synthesis of research on responsible environmental behaviour: A meta-analysis. *The Journal of Environmental Education, 18*(2), 1-8. doi:10.1080/00958964.1987.9943482

Hormio, S. (2017). Can corporations have (moral) responsibility regarding climate change mitigation. *Ethics, Policy and Environment, 20*(3), 314-332. doi:10.1080/21550085.2017.1374015

Howard-Jones, P., Sands, D., Dillon, J., & Fenton-Jones, F. (2021). The views of teachers in England on an action-oriented climate change curriculum. *Environmental Education Research, 27*(11), 1660-1680. doi:https://doi-org.libraryproxy.mic.ul.ie/10.1080/13504622.2021.1937576

Hu, S., & Chen, J. (2016). Place-based inter-generational communication on local climate improves adolescents' perceptions and willingness to mitigate climate change. *Climatic Change, 138*, 425-438. doi:10.1007/s10584-016-1746-6

Hungerford , H., & Volk, T. (1990). Changing learner behaviour through environmental education. *The Journal of Environmental Education, 21*, 8-21. doi:10.1080/00958964.1990.10753743

Hungerford, H. R. (1996). The development of responsible environmental citizenship: A critical challenge. *Journal of Interpretation Research, 1*(1), 25-37. doi: Hungerford, Harold R. (1996). The Development of Responsible Environmental Citizenship: 10.1177/109258729600100104

Hyman, E. (2020, January 2). *Who's really responsible for climate change?* Retrieved from Harvard Political Review: https://harvardpolitics.com/climate-change-responsibility/

Ignell, C., Davies, P., & Lundholm, C. (2019). A longitudinal study of upper secondary school students' values and beliefs regarding policy responses to climate change,. *Environmental Education Research, 25*(6), 614-632. doi:https://doi.org/10.1080/13504622.2018.1523369

Ihlen, O. (2009). Business and climate change: The climate response of the world's 30 largest coroprations. *3*(2), 242-262. doi:10.1080/17524030902916632

IPCC. (2014). Summary for Policymakers. In IPCC, *Climate Change 2014: Mitigation of Climate Change.* Cambridge: Cambridge University Press. Retrieved from https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_summary-for-policymakers.pdf

IPCC. (2014). Summary for Policymakers. In IPCC, *Climate Change 2014: Impacts, adaptation and vulnerability.* Cambridge: Cambridge University Press. Retrieved from https://drive.google.com/file/d/1Auac2VSmsQ9DxVVs5oce-oq4-2zRP5jw/view?usp=sharing

IPCC. (2021). Climate Change 2021: Summary for Policymakers. In V. Masson-Delmotte, A. Zhai, S. Pirani, C. Connors, S. Péan, N. Berger, . . . B. Shou, *Climate Change 2021: The Physical Science Basis.* Cambridge: Cambridge University Press.

IPCC. (2022). IPCC 2022: Summary for policy makers. In D. R. H.-O. Pörtner, *Climate Change 2022: impacts, adaptation and vulnerability. Contribution of Working Group III to the Sixth Assessment Report of the intergovernmental panel on Climate Change* (pp. 3-33). Cambridge, UK: Cambridge University Press. doi:10.1017/9781009325844.001

IPCC. (2022). Summary for Policymakers. In J. S. P.R. Shukla, *Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (pp. 1-48). Cambridge UK: Cambridge University Press. doi:10.1017/9781009157926.001

IPCC. (2022). *Working Group III contribution to the sixth assesment repoert of the intergovernmenal panel on climate change.* Geneva: UNEP/IPCC. Retrieved July 11, 2022, from https://report.ipcc.ch/ar6wg3/pdf/IPCC_AR6_WGIII_FinalDraft_FullReport.pdf

Ismail, K. M., Ayub, A. F., & Subramanian, R. (2021). Effect of environmental education modul towards pupils knowledge and behaviour intention among primary pupils. *International Journal of Academic Research in Business and Social Sciences, 11*(7), 402-407. doi:10.6007/IJARBSS/v11-i7/9241

Jackson, L., & Pang, M. F. (2017). Secondary school students' views of climate change. *International research in geographical and environmental education,* 1-13. doi:10.1080/10382046.2017.1330036

Jackson, T. (2005). *Motivating sustainable consumption. A review of evidence on consumer behaviour and behavioural change.* Surrey: Centre for Environmental Strategy. Retrieved from http://www.sd-research.org.uk/wp-content/uploads/motivatingscfinal_000.pdf

Jennings, F. (2019). Where to turn? The influence of infomration source on belief and behavior. *Journal of Risk Research, 22*(2), 909-918. doi:10.1080/13669877.2017.1422788

Jensen, B. B. (2002). Knowledge, action and pro-environmental behaviour. *Environmental Education Research, 8*(3), 325-334. doi:http://dx.doi.org/10.1080/13504620220145474

Jensen, B. B., Schnack, K., & Simovska, V. (2000). *Critical environmental and health education: research issues and challenges.* Copenhagen: The Danish University of Education.

Jia, F., & Yu, H. (2021). Action, communication, and engagement: how parents "ACE" Children's pro-environmental behaviors. *Journal of Environmental Psychology, 74,* 1-9. doi:10.1016/j.jenvp.2021.101575

Jie Li, C., & Monroe, M. (2017). Exploring the essential psychological factors in fostering hope concerning climate change. *Environmnental Education Research, 25,* 936-954. doi:10.1080/13504622.2017.1367916

Johnson, B., & Činčera, J. (2021). Relationships between outdoor environmental education program characteristics and children's environmental values and behaviors. *Journal of Adventure Education and Outdoor Learning,* 1-19. Retrieved from 10.1080/14729679.2021.2001756

Jorgenson, S., Stephens, J., & White, B. (2019). Environmental education in transition: A critical review of recent research on climate change and energy education. *The Journal of Environmental Education, 50*(3), 160-171. doi:10.1080/00958964.2019.1604478

Jurek, M., Frajer, J., Fiedor, D., Brhelova, J., Hercik, J., & Jáč, M. (2022). Knowledge of global climate change among Czech students and its influence on their beliefs in the efficacy of mitigation action. *Environmental Education Research,* 1-19. Retrieved from https://doi.org/10.1080/13504622.2022.2086687

Kahlor, L. (2007). An augmented risk information seeking model: the case of global warming. *Media Psychology, 10*(3), 414-435. doi:10.1080/15213260701532971

Kaiser, F. (1998). A general measure of ecological behaviour. *Journal of Applied Social Psychology, 28*(5), 395-422. Retrieved from https://doi.org/10.1111/j.1559-1816.1998.tb01712.x

Kaiser, F. (2007). Behaviour-based environmental attitude: Development of an instrument for adolescents. *Journal of Environmental Psychology, 28*, 242-251. doi:10.1016/j.jenvp.2007.06.004

Kaiser, F., Roczen, N., & Bogner, F. X. (2008). Competence formation in environmental education: advancing ecology-specific rather than general abilities. *Umweltpsychologie, 12*(2), 56-70. Retrieved from https://doi.org/10.5167/uzh-9249

Kaniušonytė, G. (2019). *Identity and pro-environmental behaviour in adolescence and emerging adulthood: Findings from intervention piloting study.* Villnius: Environmental Psychology Research Centre. Retrieved from https://www.researchgate.net/publication/336135475_Identity_and_Pro-Environmental_Behavior_in_Adolescence_and_Emerging_Adulthood_Findings_From_Intervention_Piloting_Study

Kaplan, A., & Garner, J. (2017). A complex dynamic systems perspective on identity and its development: The dynamic systems model of role identity. *Developmental Psychology, 53*, 2036-2051. doi:10.1037/dev0000339

Karpudewan, M., & Mohd Ali Kahn, N. S. (2017). Experiential-based climate change education: fostering students' knowledge and motivation towards the environment. *INTERNATIONAL RESEARCH IN GEOGRAPHICAL AND ENVIRONMENTAL EDUCATION, 26*(3), 207-222. doi:https://doi.org/10.1080/10382046.2017.1330037

Kellstedt, P. M. (2008). Personal Efficacy, the information environment, and attitudes towards global warming and climate change in the United States. *Risk Analysis, 28*(1), 113-127. doi:10.1111/j.1539-6924.2008.01010.x

Kelly, G. (1991). *The psychology of personal construct* . London: Routledge.

Khadka, A., Lie, C. J., Stanis, S. W., & Morgan, M. (2021). Unpacking the power of place-based education in climate change communication. *Applied environmental education and communication, 20*(1), 77-91. doi:10.1080/1533015X.2020.1719238

Kirwan, P. (2021, March). *What we do*. Retrieved from Iirsh Schools Sustainability Network: https://www.issn.ie/what-we-do

Klockner, C. (2013). A comprehensive model of the psychology of environmental behavior - A meta analysis. *Global Environmental Change, 23*, 1028-1038. doi:http://dx.doi.org/10.1016/j.gloenvcha.2013.05.014

Klockner, C., & Blobaum, A. (2010). A comprehensive action determination model: Towards a broader understanding of ecological behaviour using the example of travel mode choice. *Journal of Environmental Psychology, 30*(4), 574-586. doi:https://doi.org/10.1016/j.jenvp.2010.03.001

Klockner, C., Matthies, E., & Hunecke, M. (2006). Problems of Operationalizing Habits and Integrating Habits in Normative Decision-Making Models. *Journal of Applied Social Psychology, 33*(2), 396-417. doi:https://doi.org/10.1111/j.1559-1816.2003.tb01902.x

Kollmuss, A., & Agyeman, J. (2002). Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behaviour? *Environmental Education Research, 8*(3), 239-260. doi:http://dx.doi.org/10.1080/13504620220145401

Kovács, J., Medvés , D., & Pántya, J. (2020). The relationship between environmental knowledge of preteens and their choice among plastic and non-plastic materials for a manual task. *Environmental Education Research, 26*(6), 849-863. doi:https://doi.org/10.1080/13504622.2020.1752363

Krettenauer, T. (2017). Pro-environmental behaviour and adolescent moral development. *Research on Adolescence, 27*(3), 581-593. doi:https://onlinelibrary.wiley.com/doi/10.1111/jora.12300

Kuhn, T. (1996). *The structure of scientific revolutions* (3rd ed.). Chicago: University of Chicago Press.

Kuipers, K., & Hysom, S. (2014). Common problems and solutions in experiements. In M. Webster, & J. Sell, *Laboratory Experiments in the Social Sciences* (2nd ed., pp. 145-177). Academic Press. doi:10.1016/B978-0-12-404681-8.00007-8

Laerd Statistics. (2022). *Sphericity - Statistical Guides*. Retrieved January 27, 2023, from Laerd Statistics: https://statistics.laerd.com/statistical-guides/sphericity-statistical-guide.php

Lang, J. (2022). *IPCC Explainer: Stopping Climate Change.* Retrieved from Energy and Climate Intelligence Unit: https://ca1-eci.edcdn.com/infographics/IPCC_WGIII_Options_15_Aug_22.pdf?v=1664285366

Law, M., Stewart, D., Pollock, N., Letts, L., Bosch, J., & Westmoreland, M. (1998). *Critical Review Form for Quantitative Studies.* Hamilton: McMaster University. Retrieved from https://unisa.edu.au/siteassets/episerver-6-files/global/health/sansom/documents/icahe/cats/mcmasters_quantitative-review.pdf

Law, M., Stewart, D., Pollock, N., Letts, L., Bosch, J., & Westmorland, M. (1998). *Guidelines for critical review form - Quantitative studies.* Hamilton: McMaster University. Retrieved from https://unisa.edu.au/siteassets/episerver-6-files/global/health/sansom/documents/icahe/cats/mcmasters_quantitative-review.pdf

Lehnert, M., Fiedor, D., Frajer, J., Hercik, J., & Jurek, M. (2019). Czech students and mitigation of global warming: beliefs and willingness to take action. *Environmental Education Research*, 1-26. doi:10.1080/13504622.2019.1694140

Leigh, K. (2009). Energy Busters Norfol Schools Fight Climate Change. *Environmental Education*, 13-14.

Leiserowitz, A., Smith, N., & Marlon, J. (2011). *American teens' knowledge of climate change.* New Haven: Yale Project on climate change communication.

Lenton, T. M., Rockstrom, J., Gaffney, O., Rahmstorf, S., Richardson, K., Steffen, W., & Joachiim Schellnhuber, H. (2019). Climate tipping points - too risky to bet against. *Nature, 575*, 592-598. doi:https://media.nature.com/original/magazine-assets/d41586-019-03595-0/d41586-019-03595-0.pdf

Lester, B. T., Ma, L., Lee, O., & Lambert, J. (2006). Social activism in elementary science education: a science, technology, and society approach to teach global warming. *International Journal of Science Education, 28*(4), 315-339. doi:https://doi.org/10.1080/09500690500240100.

Li, C. J., Monroe, M., Oxarart, A., & Ritchie, T. (2021). Building teachers' self-efficacy in teaching about climate change through educative curriculum and professional development. *Applied Environmental Education and Communication, 20*(1), 34-48. doi:https://doi-org.libraryproxy.mic.ul.ie/10.1080/1533015X.2019.1617806

Lockhart, R., & Craik, F. (1990). Levels of processing: A retrospective commentary on a framework for memory research. *Canadian Journal of Experimental Psychology, 44*(1), 87-112. Retrieved from 10.1037/h0084237

Lunholm, C. (2019). Where to look and what to do? Blank and bright spots in research on environmental and climate change education. *Environmental Education Research, 25*(10), 1427-1437. doi:10.1080/13504622.2019.1700066

Maciejewski, M. (2020). Quasi-experimental design. *Biostatistics and Epidemiology, 4*(1), 38-47. doi:10.1080/24709360.2018.1477468

Malhi, Y., Franklin, J., Seddon, N., Solan, M., Turner, M., Field, C., & Knowlton, N. (2020). Climate change and eco-systems: threats, opportunities and solutions. *Philosophical transactions of the Royal Society B, 375*(1794). doi:https://doi.org/10.1098/rstb.2019.0104

Manoli, C., johnson, B., Hadjichambis, A., Hadjichambi, D., Georgiou, Y., & Ioannou, H. (2014). Evaluating the impact of the Earthkeepers Earth education program on children's ecological understandings, values and attitudes, and behaviour in Cyprus. *Studies in Educational Evaluation, 41*, 29-37. doi:http://dx.doi.org/10.1016/j.stueduc.2013.09.008

Martin, C., & Czellar, S. (2017). Where do biospheric values come from? A connectedness to nature perspective. *Journal of Environmental Psychology, 52*, 56-68. doi:https://doi.org/10.1016/j.jenvp.2017.04.009

Martinez Sainz, M., Mallon, B., & Oberman, R. (2019). *A Framework for Assessing the Impact of Climate Change Education in Schools.* European Educational Research Association. Retrieved from https://eera-ecer.de/ecer-programmes/conference/24/contribution/48605/

Mason, L., Ronconi, A., Scrimin, S., & Pazzaglia, F. (2021). Short-term exposure to nature and benefits for students' cognitive performance: a reviee. *Educational Psychology Review*, 1-39. doi:10.1007/s10648-021-09631-8

Matthies, E., Selge, S., & Klockner, C. A. (2012). The role of parental behaviour for the development of behaviour specific environmental norms - The example of recycling and re-use behaviour. *journal of Environmental Psychology, 32*(3), 277-284. doi:10.1016/j.jenvp.2012.04.003

McDonald, J. (2008). Measuring personality constructs: The advantages and disadvantages of self-reports, informant reports and behavioural assessments. *Enquire, 1*(1), 75-94.

Retrieved from https://www.nottingham.ac.uk/sociology/documents/enquire/volume-1-issue-1-dodorico-mcdonald.pdf

McIntyre, O. (2020, August). *The Irish Supreme Court Judgment in Climate Case Ireland: 'One Step Forward and Two Steps Back'.* Retrieved from IUCN: https://www.iucn.org/news/world-commission-environmental-law/202008/irish-supreme-court-judgment-climate-case-ireland-one-step-forward-and-two-steps-back

McNally, B. (2020). *Citizen's views of climate action in Ireland: Insights on media use, trusted sources and perceptions.* Wexford: Environmental Protection Agency. Retrieved from https://www.epa.ie/publications/research/climate-change/Research_Report_344.pdf

McNeal, P., Petcovic, H., & Reeves, P. (2017). What is motivating middle-school science teachers to teach climate change? *International Journal of Science Education, 39*(8), 1069-1088. doi:https://doi.org/10.1080/09500693.2017.1315466

Mead, E., Roser-Renouf, C., Rimal, R., Flora, J., Maibach, E., & Leiserowitz, A. (2012). Information seeking about global climate change among adolescents: The role of risk perceptions, efficacy beliefs and parental influences. *Atlantic Journal of Communications, 20*(1), 31-52. doi:10.1080/15456870.2012.637027

Meehan, C. R., Levy, B. L., & Collet-Gildard, L. (2018). Global climate change in U.S. high school curricula: Portrayals of the causes, consequences, and potential responses. *Science Education, 102*(3), 498-528. doi:https://doi-org.libraryproxy.mic.ul.ie/10.1002/sce.21338

Mellis, C. (2020). How to choose your study design. *Journal of Paediatrics and Child Health*, 1-5. doi:10.1111/jpc.14929

Michie, S., Johnston, M., Francis, J., Hardeman, W., & Eccles, M. (2008). From Theory to Intervention: Mapping Theoretically derived behavioural determinants to behavour change techniques. *Applied Psychology, 57*(4), 660-680. doi:10.1111/j.1464-0597.2008.00341.x

Millar, R. (2009). *Analysing practical activities to assess and improve effectiveness: The Practical Activity Analysis Inventory (PAAI).* York: Centre ofr Innovation and Research in Science Education.

Miller, N., Kumar, S., Pearce, K., & Baldock, K. (2021). The outcomes of nature-based learning for primary school aged children: a systematic review of quantitative research.

Environmental Education Research, 1115-1140. doi:https://doi.org/10.1080/13504622.2021.1921117

Minitab Statistics. (2015, Sept). *Repeated Measures Designs: Benefits, Challenges, and an ANOVA Example.* Retrieved from Minitab: https://blog.minitab.com/en/adventures-in-statistics-2/repeated-measures-designs-benefits-challenges-and-an-anova-example

Minnock, K., Sullivan, J., & Dick, H. (2021). *Climate Action: Creating a Just and Sustainable World: Specification for Junior Cycle.* Dublin.

Mochizuki, Y., & Bryan, A. (2015). Climate change education in the context of education for sustainable development. *Journal of Education for Sustainable Development, 9*(1), 4-26. doi:10.1177/0973408215569109

Mochizuki, Y., & Bryan, A. (2015). Climate change education in the context of education for sustainable development: Rationale and principles. *Journal of Education for Sustainable Development, 9*(1), 4-26. doi:10.1177/0973408215569109

Mochizuki, Y., & Bryan, A. (2015). Climate change education in the context of education for sustainable development: Rationale and principles. *Journal of Education for Sustainable Development, 9*(1), 4-26. doi:10.1177/0973408215569109

Moellendorf, D. (2015). Climate Change Justice. *Philosophy Compass*, 173-186. doi:10.1111/phc3.12201

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLoS Med, 6*(7). doi:10.1371/journal.pmed1000097

Monroe, M., Plate, R., Oxarart, A., Bowers, A., & Chaves, W. (2017). Idenitfying effective climate change education strategies: a systematic review of the research. *Environmental Education Research*, 1-23. doi:https://doi.org/10.1080/13504622.2017.1360842

Monus, F. (2022). Environmental education policy of schools and socioeconomic background affect environmental attitudes and pro-environmental behavior of secondary school students. *Environmental Education Research, 28*, 169-196. doi:10.1080/13504622.2021.2023106

Moore, E., Wilkie, W., & Alder, J. (2001). Lighting the torch: How do intergenerational influences develop? *Advances in Consumer Research, 28*, 287-293. Retrieved from https://www.acrwebsite.org/volumes/8492/volumes/v28/NA-28/full

Movement Generation. (2022, 1 14). *Propogate, Pollinate, Practice: Curriculum tools for a just transition.* Retrieved from Movement Generation: https://movementgeneration.org/wp-content/uploads/2018/12/Propagate-Pollinate-Practice-Final.pdf

Muhlisin, M., Rosiana, I., Rahayuningsih, Y., & Suharyana, Y. (2019). The efforts to improve environmental behavior and critical thinking of students through guided inquiry-based learning on environmental education-based science. *Jurnal Penelitian dan Pembelajaran IPA, 5*(2), 202-218. doi:10.30870/jppi.v5i2.4681

Murphy, C., Smith, G., & Broderick, N. (2019). A starting point: Provide children with opportunities to engage with scientific inquiry and nature of science . *Research in Science Education*. doi:10.1007/s11165-019-9825-0

NCCA. (2009). *Aistear: the Early Childhood Curriculum Framework.* Dublin: National Council for Curriculum and Assessment. Retrieved 10 18, 2022, from https://curriculumonline.ie/getmedia/484bcc30-28cf-4b24-90c8-502a868bb53a/Aistear-Principles-and-Themes_EN.pdf

NCCA. (2020). *Draft Primary Curriculum Framework.* Dublin: National Council for Curriculum and Assessment. Retrieved 10 18, 2022, from https://ncca.ie/media/4870/en-primary-curriculum-framework-dec-2020.pdf

NCCA. (2022). *Background paper and brief for the development of Leaving Certificate Climate Action and Sustainable Development.* Dublin: National Council for Curriculum and Assessment. Retrieved 10 14, 2022, from https://ncca.ie/media/5640/background-paper-for-lc-casd_0622

NCCA. (2022). *Background paper and brief for the development of Leaving Certificate Climate Action and Sustainable Development.* Dublin: NCCA. Retrieved February 6, 2023, from https://ncca.ie/en/resources/background-paper-and-brief-for-the-development-of-leaving-certificate-climate-action-and-sustainable-development/

NCCA. (2022). *Consultation Report on the background paper and brief for the development of leaving certificate climate action and sustainable development.* Dublin: National Council for Curriculum and Assessment. Retrieved February 10, 2023, from https://ncca.ie/media/5921/bgp-casd_-consultation-report_1222.pdf

NCCA. (2022a). *Senior cycle review: Advisory report.* Dublin: National Council for Curriculum and Assessment. Retrieved 10 14, 2022, from https://ncca.ie/media/5399/scr-advisory-report_en.pdf

NCCA. (2022b). *Background paper and brief for the development of Leaving Certificate Climate Action and Sustainable Development.* Dublin: National Council for Curriculum and Assessment. Retrieved 10 14, 2022, from https://ncca.ie/media/5640/background-paper-for-lc-casd_0622

Nevin, E. (2008). Education for Sustainable Development. *Policy and Practice*, 49-63. Retrieved from https://www.developmenteducationreview.com/sites/default/files/Issue6.pdf

Nourmoradi, H., Asadi, M., Mehdi-Naghizadeh, S., Mazloomi, S., & Ghazanfari, Z. (2021). The influence of an education program on students' environmental responsibility in developing countries: evidence from Iran. *Journal of Human Behavior in the Social Environment*, 1-12. Retrieved from 10.1080/10911359.2021.1987368

Nourmoradi, H., Asadi, M., Mehdi-Naghizadeh, S., Mazloomi, S., Ghazanfari, Z., & Quam. (2021). The influence of an education program on students' environmental responsibility in developing countries: evidence from Iran. *Journal of Human Behavior in the Social Environment*, 1-12. Retrieved from 10.1080/10911359.2021.1987368

Oerke, B., & Bogner, F. (2011). Social desirability, environmental attitudes, and general ecological behaviour in children. *International Journal of Science Education*, *35*(5), 713-730. doi:https://doi.org/10.1080/09500693.2011.566897

Ojala, M. (2005). Adolescents' Worries about Environmental Risks: Subjective Well-Being, Values, and Existential Dimensions. *Journal of Youth Studies*, *8*(3), 331-347.

Ojala, M. (2012). Hope and climate change: The importance of hope for environmental engagement among young people. *Environmental Education Research, 18*, 625-642. doi:https://dx.doi.org/10.1080/13504622.2011.637157

Ojala, M. (2012). How do children cope with global climate change? Coping strategies, engagement, and well-being. *Journal of Environmental Psychology*, 225-233. doi:10.1016/j.jenvp.2012.02.004

Ormston, R., Spencer, L., Barnard, M., & Snape, D. (2014). The foundations of qualitative research. In J. Ritchie, J. Lewis, C. Nicholls, & R. Ormston, *Qualitative research*

practice: A guide for social science students and researchers (pp. 1-25). Los Angeles: Sage.

Orr, D. W. (1997). Architecture as Pedagogy. *Conservation Biology, 11*(3), 597-600. Retrieved from https://www.jstor.org/stable/2387419

Otto, S., Evans, G., Moon, M., & Kaiser, F. (2019). The development of children's environmental attitude and behaviour. *Global Environmental Change, 58,* 1-6. doi:https://doi.org/10.1016/j.gloenvcha.2019.101947

Ouellette, J., & Wood, W. (1998). Habit and intention in everyday life: The multiple processes by which past behaviour predict future behaviour. *Psychological Bulletin, 124*(1), 54-74. Retrieved from https://dornsife.usc.edu/assets/sites/208/docs/Ouellette.Wood.1998.pdf

Oyserman, D. (2015). Values, Psychology of. In J. D. Wright, *International Encyclopedia of the Social and Behavioural Sciences* (Vol. 25, pp. 36-40). Oxford: Elsevier. doi:10.1016/B978-0-08-097086-8.24030-0

Page, E. (2013). Climate Change Justice. In R. Falkner, *The Handbook of Global Climate and Environment Policy* (pp. 231-247). Chichester: Wiley-Blackwell.

Pallant, J. (2020). *SPSS survival manual: A step by step guide to data analysis using SPSS* (7th ed.). London: Routledge. doi:10.4324/9781003117452

Parahoo, K. (2014). *Nursing research: principles, process and issues* (3rd ed.). Basingstoke: Palgrave-Macmillan.

Parant, A., Pascaul, A., Jugel, M., Kerroume, M. M., & Gueguen, N. (2017). Raising students awareness to Climate Change: An illustration with binding communication. *Environment and Behaviour, 49*(3), 339-353. doi:10.1177/0013916516629191

Pasanen, T. P., Tyrväinen, L., & Korpela, K. (2014). The relationship between perceived health and physical activity indoors, outdoors in built environmnets and outdoors in nature. *Applied Psychology: Health and Well-being, 6,* 324-346. doi:https://doi-org.libraryproxy.mic.ul.ie/10.1111/aphw.12031

Payne, P. (2000). Idenitty and environmental education. *Environmental Education Research, 7*(1), 67-88. doi:10.1080/13504620124658

Pirages, D., & Ehrlich, P. (1974). *Ark II: Social response to environmental imperatives.* San Francisco: W. H Freeman and Co. .

Popper, K. (1959). *The logic of scientific discovery.* New York: Basic Books.

Prager, K. (2012). *Understanding Behaviour Change.* Edinborough : James Hutton institute.

Price, P., Jhangiani, R., Chiang, I., Leighton, D., & Cuttler, C. (2017). *Research Methods in Psychology* (3rd ed.). Seattle: Washington State University.

Pruneau, D., Doyon, A., Langis, J., Vasseur, L., Martin, G., Ouellet, E., & Boudreau, G. (2006). The Process of Change Experimented by Teachers and Students when Voluntarily Trying Environmental Behaviors. *Applied Environmental Education and Communication, 5*(1), 33-40. doi:https://doi.org/10.1080/15330150500452349

Pruneau, D., Gravel, H., Bourque, W., & Langis, J. (2003). Experimentation with a Socio-Constructivist Process for Climate Change Education. *Environmental Education Research, 9*(4), 429-446. doi:10.1080/1350462032000126096

Psychological Society of Ireland. (2019). *Code of Professional Ethics.* Dublin: PSI. Retrieved 4 21, 2021, from https://www.psychologicalsociety.ie/footer/Code-of-Ethics

Punter, P., Ochando-Pardo, M., & Garcia, J. (2011). Spanish secondary school students' notions on the causes and consequences of climate change. *International Journal of Science Education, 33*(3). doi:https://doi.org/10.1080/09500693.2010.492253

Reed, N., & Page, N. (2016). Changing behavior to being more environmentally friendly. In D. Winter, & N. Reed, *The Wiley handbook of personal construct psychology* (pp. 487-498). WIley-Blackwell. doi:https://doi.org/10.1002/9781118508275.ch39

Reed, N., & Page, N. (2016). Changing behavior to being more environmentally friendly. In D. Winter, & N. Reed, *The Wiley handbook of personal construct psychology* (pp. 487-498). WIley-Blackwell.

Riggs Stapleton, S. (2015). Environmental idenitty developmnet through social interactions, action and recognition. *The Journal of Environmental Education, 46*(2), 94-113. doi:10.1080/00958964.2014.1000813

Ritchie, S., Della Salla, S., & McIntosh, R. (2013). Retrieval practice, with or without mind mapping boosts fact learning in primary school children. *Plos One, 8*(11), 1-9. doi:10.1371/journal.pone.0078976

Robelia, B. A., Greenhow, C., & Burton, L. (2011). Environmental learning in online social networks: adopting environmentally responsible behaviours. *Environmnetal Education Research, 17*(4), 553-575. doi:10.1080/13504622.2011.565118

Robinson, A., Downey, L., Ford, T., Lomas, J., & Stough, C. (2019). Green teens: investigating the role of emotional intelligence in adolesccent environmentalism. *Personality and Individual Differences, 138,* 225-230. doi:10.1016/j.paid.2018.10.009

Roczen, N., Kaiser, F., Bogner, F., & Wilson, M. (2013). A competence model for environmental education. *Environment and Behavior, 46*(8), 972-992. doi:10.1177/0013916513492416

Ronaghi, M. H. (2022). The effect of virtual reality technology and education on sustainable behavior: a comparative quasi-experimental study. *Interactive technology and smart education,* 1-18. doi:http://dx.doi.org/10.1108/ITSE-02-2022-0025

Ross, H., Rudd, J., Skains, R. L., & Horry, R. (2021). How Big Is My Carbon Footprint? Understanding Young People's Engagement with Climate Change Education. *Sustainability, 13,* 1-19. doi:https://doi.org/10.3390/su13041961

Rossi, P., Freeman, H., & Lipsey, M. (1999). *Evaluation: A systematic approach* (6th ed.). Thousand Oaks CA: Sage.

Rousell, D., & Cutter-Mackenzie-Knowles, A. (2020). A systematic review of climate change education: giving children. *Children's geographies, 18*(2), 191-208. doi:10.1080/14733285.2019.1614532

Rudd, J., Horry, R., & Skains, R. L. (2020). You and CO2: a Public Engagement Study to Engage Secondary School Students with the Issue of Climate Change. *Journal of Science Education and Technology, 29,* 230-241. doi:https://doi.org/10.1007/s10956-019-09808-5

Sadler-Smith, E. (2015). Communicating climate change risk and enabling pro-environmental behavioral change through human resource development. *Advances in developing human resources, 17*(4), 442-459. doi:10.1177/1523422315601087

Saja Sanneh, E. (2018). *Systems thinking for sustainable development: Climate change and the environment.* AG: Springer. Retrieved from https://doi.org/10.1007/978-3-319-70585-9_10

Salazar, C., Jaime, M., Leiva, M., & Gonzalez, N. (2022). From theory to action: Explaining the process of knowledge attitudes and practices regarding the use and disposal of plastic among school children. *Journal of Environmental Psychology, 80,* 1-12. Retrieved from 10.1016/j.jenvp.2022.101777

Schultz, P., Gouveia, V., Cameron, L., Tankha, G., Schmuck, P., & Franek, M. (2005). Values and their relationship to environmental concern and conservation behaviour. *Journal of Cross-Cultural Psychology, 36*(4), 457-475. doi:10.1177/0022022198294003

Schwartz, S. H. (2012). Values and religion in adolescent development: cross-national and comparative evidence. In G. Trommsdorff, & X. Chen, *Values, religion and culture in adoelscent development* (pp. 97-122). New York: Cambridge University Press. doi:10.1017/CBO9781139013659.007

Schwartz, S., & Howard, J. (1981). A normative decision-making model of altruism. In J. Rushton, & R. Sorrentino, *Altruism and Helping Behaviour* (pp. 89-211). Hillsdale: Lawerence Erlbaum.

Sellmann, D., & Bogner, F. (2013). Effects of a 1-day environmental education intervention on environmental attitudes and connectedness with nature. *European Journal of Psychology of Education, 28*(3), 1077-1086. doi:10.1007/s10212-012-0155-0

Senge, P. (1990). *The fifth discipline: The art and science of the learning organisation.* New York: Currency Doubleday.

Sezen-Barrie, A., Miller-Rushing, A., & Hufnagel, E. (2020). 'It's a gassy world': starting with students' wondering questions to inform climate change education. *Environmental Education Research, 26*(4), 555-576. doi:10.1080/13504622.2019.1610158

Shapiro, M. (1985). A reassessment of clinical psychology as an applied science. *British Journal of Clinical Psychology, 24*, 1-11. doi:10.1111/j.2044-8260.1985.tb01308.x

Shepardson, D., Niyogi, D., Choi, S., & Charusombat, U. (2011). Students' conceptions about the greenhouse effect, global warming and climate change. *Climatic Change, 104*, 481-507. doi:10.1007/s10584-009-9786-9

Sia, A., Hungerford, H., & Tomera, A. (1986). Selected predictors of responsible environmental behaviour: An analysis `. *The Journal of Environmental Education*, 31-40. doi:10.1080/00958964.1986.9941408

Sinatra, G., Kardash, G., Taasoobshirazi, G., & Lombardi, D. (2012). Promoting Attitude Change and Expressed Willingness to Take Action Toward Climate Change in College Students. *Instructional Science, 40*(1), 1-17.

Smith, J., & Noble, H. (2014). Bias in research. *Evidence based nursing, 17*(4), 1-2. Retrieved from https://ebn.bmj.com/content/ebnurs/17/4/100.full.pdf

Smith-Sebasto, N., & Fortner, R. (1994). The environmental action internal control index: voluntary mitigation and barriers to behaviour change. *The Journal of Environmental Education, 25*(4), 23-29. doi:10.1080/00958964. 1994.9941961.

Somerwill, L., & Wehn, U. (2022). How to measure the impact of citizen science on environmental attitudes, behaviour and knowledge? A review of state-of-the-art approaches. *Environmental Sciences Europe, 34*(18), 1-13. doi:10.1186/s12302-022-00596-1

Spitzer, S., & Weber, D. (2019). Reporting biases in self-assessed physical and cognitive health status of older Europeans. *PLoS One, 8*(14), 1-10. doi:10.1371/journal.pone.0223526

SSGA. (2020). *Carbon Footprinting: An investors toolkit.* New York: SSGA. Retrieved from https://www.ssga.com/library-content/pdfs/insights/carbon-footprinting-an-anvestor-toolkit.pdf

Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology, 29*(3), 31-42. doi:https://doi.org/10.1016/j.jenvp.2008.10.004

Stern, P. (2000). Toward a coherent theory of environmentally significant behaviour. *Journal of Social Issues, 56*(3), 407-424. Retrieved from https://web.stanford.edu/~kcarmel/CC_BehavChange_Course/readings/Stern_metareview_2000.pdf

Stevenson, K. T., Nils Peterson, M., & Bondell, H. D. (2018). Developing a model of climate change behaviour among adolescents. *Climate Change,* 1-15. Retrieved from https://doi.org/10.1007/s10584-018-2313-0

Stevenson, K., & Peterson, N. (2015). Motivating action through fostering climate change hope and concern and avoiding despair among adolescents. *sustainability, 8*(1). Retrieved from https://doi.org/10.3390/su8010006

Stevenson, K., Lashley, M., Chitwood, M., & et al. (2015). How emotion trumps logic in climate change risk perception: exploring the affective heuristic among wildlife science students. *Hum Dimens Wildl, 20,* 501-513. Retrieved from https://doi.org/10.1080/10871209.2015.1077538

Stevenson, K., Peterson, M., & Bondell, H. (2014). Overcoming skepticism with education: interacting influences of worldview and climate change knowledge on perceived climate

change risk among adolescents. *Climate Change, 126,* 293-304. doi:https://doi.org/10.1007/s10584-014-1228-7

Stripple, J., & Stephan, H. (2013). Global Governance. In R. Falkner, *The handbook of global climate and environmental policy* (pp. 146-162). Chichester: Wiley-Blackwell. Retrieved from 10.1002/9781118326213.ch9

Sumrall, W., & Sumrall, K. (2021). Changing attitude into behavior: How to reduce carbon dioxide emissions. *Science Activities, 58*(1), 23-33. Retrieved from 10.1080/00368121.2021.1885334

Sund, L. (2016). Facing global sustainability issues: teachers' experiences of their own practices in environmental and sustainability education. *Environmental Education Research, 22*(6), 788-805. doi:10.1080/13504622.2015.1110744

Tallulah, T. (2018, January 10). *Individual vs Collective: Are you responsible for fixing climate change?* Retrieved from resilience: https://www.resilience.org/stories/2018-01-10/individual-vs-collective-are-you-responsible-for-fixing-climate-change/

Taylor , M., & Watts, J. (2019, October). *Revealed: the 20 firms behind a third of all carbon emissions.* Retrieved from The Guardian: https://www.theguardian.com/environment/2019/oct/09/revealed-20-firms-third-carbon-emissions

Thøgersen, J. (1996). Recycling and Morality: A critical review of the literature. *Environment and Behaviour, 28,* 546-558. doi:https://doi.org/10.1177/0013916596284006

Thomas, L. (2013, 2022 12). *Control groups and treatment groups: uses and examples.* Retrieved Feb 2, 2023, from Scribbr: https://www.scribbr.com/methodology/control-group/

Thompson, S. (2017, Feb 25). Students pull on the green jersey: The Green Schools scheme has boosted environmental awareness around Ireland. *The Irish Times*, p. 6. Retrieved 07 2022, 13, from http://libraryproxy.mic.ul.ie/login?url=https://www.proquest.com/newspapers/students-pull-on-green-jersey/docview/1871703076/se-2?accountid=55804

Timms, M. (2016, March). *The relationship between corporations and climate change.* Retrieved from World Finance: https://www.worldfinance.com/special-reports/the-relationship-between-corporations-and-climate-change

Tomlinson, Y. N. (2023, January 3). The importance of engaging with ontology and epistemology as an ECR. *Careers and employment, education, teaching and learning*. Retrieved from https://www.bps.org.uk/psychologist/importance-engaging-ontology-and-epistemology-ecr

Tonglet, M., Phillips, P., & Read, A. (2004). Using the theory of planned behaviour to investigate the determinants of recycling behaviour: a case study from Brixworth UK. *Resources, Conservation and Recycling, 41*(3), 191-214. doi:https://doi.org/10.1016/j.resconrec.2003.11.001

Transition Network. (2021, November). *Principles*. Retrieved from Transition Network: https://transitionnetwork.org/about-the-movement/what-is-transition/principles-2/

Truelove, H., & Parks, C. (2012). Perceptions of behaviours that cause and mitigate global warming and intentions to perform these behaviours. *Journal of Environmental Psychology, 32*, 246-259. doi:http://dx.doi.org/10.1016/j.jenvp.2012.04.002.

Tucker, R., & Izadpanahi, P. (2017). Live gree, think green: Sustainable school architecture and children's environmental attitudes and behaviours. *Journal of Environmental Psychology, 51*, 209-216. doi:10.1016/j.jenvp.2017.04.003

Tukker, A., & Jansen, B. (2008). Environmental impacts of products: A detailed review of studies. *Journal of Industrial Ecology, 10*(3), 159-182. doi:https://doi.org/10.1162/jiec.2006.10.3.159

UCLA. (2016). *What does Cronbach's alpha mean?* Retrieved Feb 1, 2023, from UCLA Statistical Methods and Data Analysis: https://stats.oarc.ucla.edu/spss/faq/what-does-cronbachs-alpha-mean/

UENSCO. (2021). *Getting every school climate-ready: how countries are integrating climate change issues in education.* Paris: UNESCO. Retrieved 10 14, 2022, from https://unesdoc.unesco.org/ark:/48223/pf0000379591

Uitto, A., Boeve-de pauw, J., & Saloranta, S. (2015). Participatory school experiences as facilitators for adolescents' ecological behavior. *Journal of Environmental Psychology, 43*, 55-65. doi:10.1016/j.jenvp.2015.05.007

Unal, A., Steg, L., & Granskaya, J. (2019). “To support or not to support, that is the question”. Testing the VBN theory in predicting support for car use reduction policies in Russia. *Transp. Res. Part A Policy Pract, 119*, 73-81. doi:10.1016/J.TRA.2018.10.042

UNDP and University of Oxford. (2021). *People's Climate Vote.* Oxford: UNDP. Retrieved Feb 21, 2021, from https://www.undp.org/content/undp/en/home/librarypage/climate-and-disaster-resilience-/The-Peoples-Climate-Vote-Results.html

UNESCO. (2010). *Climate change education for sustainable development.* Paris: UNESCO. Retrieved from https://unesdoc.unesco.org/ark:/48223/pf0000190101.locale=en

UNESCO. (2019). *Framework for the implementation of Education for Sustainable Development (ESD) beyond 2019.* Paris: UNESCO. Retrieved from https://unesdoc.unesco.org/ark:/48223/pf0000370215?posInSet=3&queryId=193a9aaa-7167-4d98-8436-9f6361

UNESCO. (2020). *Education for Sustainable Development: A roadmap.* Paris: UNESCO. Retrieved from https://www.gcedclearinghouse.org/resources/education-sustainable-development-roadmap

UNESCO. (2021). *Getting every school climate-ready: how countries are integrating climate change issues in education.* Paris: UNESCO. Retrieved 10 14, 2022, from https://unesdoc.unesco.org/ark:/48223/pf0000379591

UNESCO/UNEP. (2011). *Climate change starter's guidebook: An issues guide for education planners and practitioners.* Paris: UNESCP/UNEP. Retrieved from https://www.gcedclearinghouse.org/resources/climate-change-starters-guidebook-issues-guide-education-planners-and-practitioners?language=en

United Nations. (1992). *United Nations Framework Convention on Climate Change.* Madrid: UN. Retrieved 08 9, 2021, from https://unfccc.int/files/essential_background/background_publications_htmlpdf/application/pdf/conveng.pdf

Valdez, R., Peterson, M. N., & Stevenson, K. (2018). How communication with teachers, family and friends contributes to predicting climate change behaviour among adolescents. *Environmental Conservation, 45*(2), 183-191. doi:10.1017/S0376892917000443

Van Assche, K., Verschraegen, G., Valentinov, V., & Gruezmacher, M. (2019). The social, the ecological, and the adaptive. Von Bertalanffy's general systems theory and the adaptive governance of social-ecological systems. *Systems research and Behavioral science, 36*(3), 308-321. doi:https://doi-org.libraryproxy.mic.ul.ie/10.1002/sres.2587

van de Wetering, J., Leijten, P., Spitzer, J., & Thomaes, S. (2022). Does environmental education benefit environmental outcomes in children and adolescents? A meta-analysis. *Journal of Environmental Psychology, 81*, 1-12. doi:https://doi.org/10.1016/j.jenvp.2022.101782

van der Goot, W., Cristancho, S., de Carvalho Filho, M., Jaarsma, A., & Helmich, E. (2020). Trainee-environment interactions that stimulate motivation: A rich pictures study. *Medical Education, 54*, 242-253. doi:10.1111/medu.14019

van der Werff, E., Steg, L., & Keizer, K. (2013). The value of environmental self-identity: the relationship between biospheric values, environmental self-identity and environmental preferences, intentions and behaviour. *Journal of Environmental Psychology*, 55-63. doi:10.1016/j.jenvp.2012.12.006

Vazquez-Vilchez, M., Garrido-Rosales, D., Perez-Fernandez, B., & Fernandez-Oliveras, A. (2021). Using a Cooperative Educational Game to Promote Pro-Environmental Engagement in Future Teachers. *Education Sciences, 11*(691), 1-18. doi:10.3390/educsci11110691

Vechione, M., Schwartz, S., Davidov, E., Cieciuch, J., Alessandri, G., & Marsicano, G. (2019). Stability and change of basic personal values in early adolescence: a 2 year longitudinal study. *Journal of Personality, 88*, 447-463. doi:https://doi.org/10.1111/jopy.12502

Verplanken, B., & Aarts, H. (1999). Habit, Attitude, and Planned Behaviour: Is Habit an Empty Construct or an Interesting Case of Goal-directed Automaticity? *European Review of Social Psychology, 10*(1), 101-134. doi:https://doi.org/10.1080/14792779943000035

Vining, J., & Ebreo, A. (1992). Predicting recycling behaviour from global and specific environmental attitudes and changes in recycling opportunities. *Journal of Applied Social Psychology, 22*(20), 1580-1607. doi:10.1111/j.1559-1816.1992.tb01758.x

Wade, R. (2014). Learning for sustainability: the challenges for education policy and practice. In H. Atkinson, & R. Wade, *The challenges of sustainability: linking politics, educaiton and learning* (pp. 63-86). Bristol: Bristol Policy Press.

Wainwright, T., & Mitchell, A. (2020). *Psychology and the climate and environmental crisis.* London: British Psychological Society. Retrieved from https://cms.bps.org.uk/sites/default/files/2022-08/Clinical%20Psychology%20Forum%20332%20-%20Psychology%20and%20the%20climate%20and%20environmental%20crisis.pdf

Watkins, D., & Halton, C. (2010). *The big picture on biodiversity and climate change.* Ontario: Biodiversity and Education and Awareness Network.

Webster, M., & Sell, J. (2014). *Laboratory Experiments in the Social Sciences* (2nd ed.). New York: Elsevier. doi:https://doi.org/10.1016/C2011-0-07562-2

Wen, W., & Lu, S. (2013). Marine environmental protection knowledge, attitudes, behaviors, and curricular involvement of Taiwanese primary school students in senior grades. *Environmental Education Research, 19*, 600-619. doi:10.1080/13504622.2012.717219

Whitmarsh, L. (2008). What's in a name? Commonalities and differences in public understanding of "climate change" and "global warming". *Public Understanding of Science, 18*(4), 401-420. doi:https://doi-org.libraryproxy.mic.ul.ie/10.1177/0963662506073088

Whyte, K. (2019). Too late for indigenous climate justice: Ecological and relational tipping points. *WIREs Climate Change*, 1-7. Retrieved from 10.1002/wcc.603

Wigfield, A., Byrnes, J., & Eccles, J. (2006). Development during early and middle adolescence. In P. Alexander, & P. Winne, *Handbook of Educational Psychology* (pp. 87-113). Mahwah: Lawrence Erlbaum Associates Publishers.

Working Group III of the IPCC. (2022). *Climate Change 2022 Mitigation of Climate Change.* Geneva: IPCC. Retrieved from https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_SPM.pdf

Wu, J., & Otsuka, Y. (2021). Pro-climate behaviour and the influence of learning sources on it in Chinese adolescents. *International research in geographical and environmnetal education, 30*(1), 24-38. doi:10.1080/10382046.2020.1761063

Yang, B., Wu, N., Tong, Z., & Sun, Y. (2022). Nature-based environmental education improves environmental awarness and environmental attitudes. *Environmental Research and Public Health, 19*, 1-19. doi:https://doi.org/10.3390/ijerph19116483

Yli-Panula, E., Jeronen, E., & Lemmetty, P. (2020). Teaching and learning methods in geography promoting sustainability. *Education Sciences, 10*(5), 1-18. doi:http://dx.doi.org/10.3390/educsci10010005

Zeidner, M., & Endler, N. (1996). *Handbook of coping: Theory, research, applications.* New York: John Wiley & Sons.

Zografakis, N., Menegaki, A., & Tsagarakis, K. (2008). Effective education for energy efficiency. *Enery Policy, 36*(8), 3226-3232. doi:10.1016/j.enpol.2008.04.021

Zsóka, A., Szerényi, Z., Szechy, A., & Kocsis, T. (2013). Greening due to environmental education? Environmental knowledge, attitudes, consumer behavior and everyday pro-environmental activities of Hungarian high school and university students. *Journal of Cleaner Production, 48*, 126-138. Retrieved from https://doi.org/10.1016/j.jclepro.2012.11.030

6. Appendices

5.1 Appendix 1: Table of studies

Literature review and synthesis of findings

Green	Added to table
Clear	Not relevant
Yellow	Included in table already
Purple	Mention in litt review

		Table 3							
		Mapping the field: An overview of the included studies							
No.	**Author and date**	**Title**	**Participant details / Number of participants**	**Type of Study**	**Intervention**	**Measures**	**Comparator**	**Main Findings**	**Environmental behaviours**
1	(Balunde, Perlaviciute, & Truskauskaite-Kunevicine, Sustainability in Youth: Environmental Considerations in Adolescence and	Sustainability in Youth: Environmental Considerations in Adolescence and Their Relationship to Pro-environmental Behaviour	Study 1: N = 256 Age Range: 14-18 (*M=15.33)* Study 2: N= 349 Age Range: 13-18 (*M=16.07)* Study 3: N= 905 Age Range: 13-17 (M=15.23) All second level students Lithuania 13 schools in total	Correlational Study using factor analysis and structural equation modelling	Survey	Schwartz's values instrument (Schwartz, 1992) (Steg et al., 2012) "An established measure of environmental self-identity" (van der Waff et al., 2013) "an established instrument to measure personal norms (van der Waff et al., 2013)	No	Biospheric values were indirectly related to 3 environmental behaviours via environmental self-identity and personal norms Personal norms explained 53-56% of variance in 3 environmental behaviours .	Recycling Travelling in an environmentally friendly manner Purchasing sustainably produced goods

	Their Relationship to Pro-environmental Behavior, 2020)								
2	Stevenson, K Nils Peterson, M Bondell, H (2018)	Developing a model of climate change behaviour among adolescents.	N=1041 Age Range N= 11-15 *(M = unknown)* USA (California) 30 schools	Quasi Experimental study (RCT) with pre and post surveys using treatment and control groups	A 4 part CCE programme with sections on knowledge, concern, hope and behaviour	Adolescent climate change knowledge questionnaire (Stevenson K. , Peterson, Bondell, & et al., Overcoming skepticism with education: interacting influences of worldview and climate change knowledge on perceived climate change risk among adolescents, 2013) Adolescent Climate Change Hope Scale (Stevenson, Lashley, Chitwood, & et al., 2015) Adolescent Climate Change concern scale (Leiserowitz, Smith, & Marlon, 2011) Pro-environmental behaviour scale (Stevenson, Peterson, & Bondell, 2014)	Yes	CCE programme causes knowledge gains Weak direct relationship between change in knowledge and change in behaviour No direct relationship between hope, concern or behaviour Increase in knowledge predicts increased Hope and Concern which together increased the level of climate mitigation behaviours Hope is a slightly stronger predictor of behaviour than concern	Self-reported participation in climate change mitigation behaviours (as per behaviour scale)

3	(Stevenson & Nils Peterson, 2015)	Motivating action through fostering climate change hope and concern and avoiding despair among adolescents	N= 1486 Age range = 11-15 Middle school students USA 30 schools	Correlational study	Survey based	Knowledge of Climate change scale (Leiserowitz et al., 2011) Climate change concern (Leiserowitz, Smith, & Marlon, 2011) Measures of hope scale (Snyder et al., 1991)(Li et al, unpublished) Pro-environmental behaviour of children and adults (Ojala, Hope and climate change: The importance of hope for environmental engagement among young people, 2012)	No	Climate change hope positively related to behaviour and despair negatively related to behaviour Hope is a predictor of pro-environmental behaviour Hope acts as a motivator towards environmental action rather than increasing resiliency	Communicating concrete things that adolescents can do to address climate change and communicating that their actions can make a difference can lead to more environmental behaviour in general
4	Fielding, K. S., & Head, B. W. (2012)	Determinants of young Australians' environmental actions: the role of responsibility attributions, locus of control, knowledge, and attitudes	N=1529 (Group 1 only, Group 2 18-25) Age range = 12-17 Mean age = 14.63 (*sd=1.43)* Australia Convenience sample	Correlational study	Survey based	Instruments developed by the authors for the paper. Cronbach's Alpha and reliability reported for each one	no	Association between collective responsibility, internal locus of control, pro-environmental behaviour, and environmental concern	

5	(Jie Li & Monroe, 2017)	Exploring the essential psychological factors in fostering hope concerning climate change	N= 728 All high school students (16-18) 18 schools in 6 south eastern States USA	Correlational study	Survey based	Knowledge of Climate change scale (Leiserowitz et al., 2011) Self-efficacy Scale (Schwarzer et al. 1995) Hope concerning Climate Change (Snyder et al., 2001) Concern about Climate Change (1991)		Model building, meaningful action and being effective are significant correlates with hope	
6	(Mead, et al., 2012)	Information seeking about global climate change among adolescents: The role of risk perceptions, efficacy beliefs, and parental influences	Joint Parent and Child sample First group N=250 Second group N= 273 Age range of children = 13 – 17 USA	Correlational study	Survey based	Adolescent attitudes towards climate friendly behaviours Perceived Risk Efficacy Beliefs Adolescent Information seeking		Adolescents who understand the risks of climate change are more likely to seek out information about the topic and to change their behaviour accordingly	
7	(Otto, Evans, Moon, & Kaiser, 2019)	The development of children's environmental attitude and behaviour	N=118 Primary school age Mean age = 6.6, 10.3, 14.2, 17.5	Longitudinal		NEP Scale assessed attitude and behaviour (Dunlap, Van Liere, Mertig, & Jones, 2000) Ecological Behaviour scale (Kaiser, A general measure of ecological behaviour, 1998)		Environmental attitude and behaviour form around age 7, increase until age 10, level off until age 14 and declines after 14 – adolescence leads to a disruption in attitude. Environmental actions develop from childhood to early adolescence and starts consolidating from age 10 on Moral or Pro-social reasoning appears disrupted between the ages of 12 and 14	Recycling bottles Turning off lights Using public transport Leaving phone charger plugged in when not in use Flying frequency

8	(Oerke & Bogner, 2011)	Social Desirability, Environmental Attitudes, and General Ecological Behaviour in Children	N= 218 Primary School Age Germany	Correlational	Survey Based	Ecological values measure 2-MEV (Bogner & Wiseman, 2006) Assessment of general ecological behaviour (Kaiser, 2007) Social desirability RCMAS Lie scale for children	no	Social desirability is not a major factor on environmental behaviour for adolescents	
9	(Reed & Page, Changing behavior to being more environmentally friendly, 2016)	Changing behaviour to being more environmentally friendly: A PCP perspective	N=50 Adults USA	Correlational	PCP based repertory grid survey	Diagnostic research method of repertory grids to conduct surveys (McGettigan et al, 2013	No	Participants reported that they wanted to be greener but didn't act on the desire because climate change is a relatively unimportant issue because of the climate	
10	(Ignell, Davies, & Lundholm, 2019)	A longitudinal study of upper secondary school students' values and beliefs regarding policy responses to climate change	N=212 Upper Secondary school students T1 Age = 17 T2 Age = 18 One year apart Sweden	Longitudinal	Survey based over 2 points in time Classroom intervention	Value orientations (de Groot & Steg, 2007) Beliefs instrument measuring perceived efficacy of different forms of social action that offer ways to reduce greenhouse emissions Behavioural norms instrument (Ojala, 2005) (Sinatra, Kardash, Taasoobshirazi, & Lombardi, 2012)	No	No direct relationship between change in value orientation and change in norms – indirect changes based on changing beliefs in the efficacy of education and tax policies Students who became more egoistic are less likely to take personal action Orientation towards biospheric values was positively associated with willingness to reduce personal consumption and to accept higher prices	Differences in students' collective beliefs about collective action, reliance on market forces, government interventions, role of taxes and subsidies, regulation and belief that governments and organisations should shoulder the responsibility of climate change

11	(Bofferding & Kloser, Middle and high school students conceptions of climate change mitigation and adaption strategies, 2015)	Middle and high school students' conceptions of climate change mitigation and adaptation strategies	387 Students Middle School N=162 (Age range 11-14) High School N=225 (14-18) USA	Quasi-Experimental pre test, instruction, post test design	Six Unit Curriculum on Climate Change	Open response questions on reducing CO2 and preparing for global warming questions coded by frequency and theme		For mitigation strategies, students most common responses were transportation related then energy use related then plant related For adaption, temperature regulation, building materials, shade, rising sea level and adapting crops to hotter climate came up Students find it more difficult to consider adaptation to CC than mitigation	Students' overall knowledge improved with intervention Students understanding the conserving energy can help increased greatly Students conflate reducing emissions with zero emissions Students find it difficult to justify mitigation responses
12	(Shepardson, Niyogi, Choi, & Charusombat, 2011)	Students' conceptions about the greenhouse effect, global warming, and climate change	High School Students N=51 US Midwest	Mixed methods	None	Content analysis of 4 open ended questions and a drawing		41% of students understand rising CO2 levels lead to temperature increase Very few students understand regional variations and consider climate change from their own region only Students overestimate the effect it will have on wild animals and plants and underestimate on agriculture Many students believe that humans will develop new technologies to combat global warming	Students who do not feel that Climate change will have a consequence for them are more likely to believe that humans will find new technologies to help with climate change

13	(Sellman & Bogner, 2013)	Effects of a 1-Day Environmental Education Intervention on Environmental Attitudes and Connectedness with Nature	N=114 High School students German Age range 15-19	Quasi experimental pre test, intervention post test	1-day environmental education programme on climate change 2 modules, student centred learning stations on theory and how CC affects different places and eco systems	Ecological values measure 2-MEV (Bogner & Wiseman, 2006) Inclusion of nature in self (INS) Schultz 2001)		A person's environmental attitudes are related to the degree to which they feel connected to nature	Going outside is not as effective as combining nature experiences with learning activities that encourage students to actively and consciously deal with the environment
14	**Invalid source specified.**	Development and validation of the ACSI: measuring students' science attitudes, pro-environmental behaviour, climate change attitudes and knowledge	N¬ 671 Secondary school students across five European countries	Correlation study	Questionnaire based	Attitudes towards Climate Change and Science Instrument (ACSI) self-developed, measures science related and environmental related attitudes.		Shows weak but significant relationships between science related and environment related attitudes.	
15	(Sumrall & Sumrall, 2021)	Changing attitude into behaviour: How to reduce carbon dioxide emissions.	Eight grade classroom	Specific activities were developed and tested and		Criteria of changing attitude into behaviour **Invalid source specified.** 5E model of behaviour		Activities developed to engender an environmental attitude towards climate change	Letter writing Quantification of recycling

				building a series of activities					
16	**Invalid source specified.**	The relationships between values, belief, personal norms, and climate conserving behaviours of Malaysian primary school students	N=300 Year 5 and 6 primary school students aged 11 and 12 years old.		Questionnaire	SmartPLS 2.0 **Invalid source specified.** was used to test the six hypotheses derived from the relationships that exist between the constructs of VBN theory **Invalid source specified.**.		The findings suggest that the physiological concerns, value, belief, and personal norms included in the model are highly predictive of the climate change behaviours. The models derived from the study could be used to design climate change education curriculums in schools.	
17	(Khadka, Lie, Stanis, & Morgan, 2021)	Unpacking the power of place-based education in climate change communication	N=29 High school students	Correlational study	Pre and post-test questionnaire	Four items were used to test knowledge about climate change and the concentration of carbon in the atmosphere. (Leiserowitz, Smith & Marlon, 2011)		Increase in students' knowledge regarding climate change, sense of responsibility, sense of hope and behavioural intention	Students were more willing to take action to help solve CC, willing to tell a friend or family member about CC, willing to change their behaviour.
18	(Pruneau, et al., 2006)	The Process of Change Experimented by Teachers and Students when Voluntarily Trying Environmental Behaviours	N=95 25 teachers 75 students aged 9 to 17 Elementary secondary education	Quasi experimental A climate change education training	Questionnaires and individual interviews	Process of change analysed by content analysis of individual interviews ad the composition of narratives of individual change **Invalid source specified.** the six stages in individuals process of change **Invalid source specified.**		All 25 teachers successfully integrated new environmental behaviours. Most succeeded in maintaining such behaviours. For the 75 students the success rate for new behaviours was excellent with several and moderate with others. Motivation to change was learning more about CC, a	Reduction in consumption of electricity, water, paper towels and over packaged products. Students recycled reduced consumption of water and electricity. Fewer car rides and litter picking.

				project(The ecosage Circle)				reflective activity on values and group discussions. Students changed because in an effort to save the planet, animals and plants.	
19	(Ismail, Ayub, & Subramanian, 2021)	Effect of environmental education module towards pupils knowledge and behaviour intention among primary pupils	N=32 5th class pupils Malaysia	Quasi experimental pre and post test x 3	Environmental education module	25 multiple choice question test Likert scale response on knowledge intention	no	There was a knowledge increase even six months after the environmental education module was taught EE modules are able to ignite the intention behaviour towards the environment but unable to retain the behaviour intention into the 1 month and six month post test	Not mentioned
20	(Wu & Otsuka, 2021)	Pro-climate behaviour and the influence of learning sources on it in Chinese adolescents	N=657 China High Schools (11th Grade)	Cross tabulation	Survey based	Cross tabulation	No	different learning sources have different influences on pro-climate behaviours. Activity-based learning tends to be more conductive to pro-climate behaviour than other sources, especially media, which is the most reported source in relation to climate change in this study	
21	(Valdez, Peterson, & Stevenson, 2018)	How communication with teachers, family and friends contributes to predicting climate change	N=1371 Middle school students 11 to 14 years old		Survey	Climate change behaviour, climate change knowledge, climate change concern and to determine how often climate change was discussed measured	no	Students were more likely to discuss climate change with teachers it did not relate to climate change behaviour. Rare discussions with friends and family predicted climate change behaviour.	

		behaviour among adolescents	North Caroline, USA			using **Invalid source specified.**		Teaching strategies including group discussion, project and informal learning help discussion with peers and solidify behaviours.	
22	(Alexander & Poyyamoli, 2017)	Climate change education for school students-activity-based teaching learning approach to create knowledge, attitudes skills and behavioural change	N=180 students Two middle schools Tamil Nadu, India				Yes		
23	(Arya & Maul, 2016)	The building of knowledge, language, and decision-making about climate change science: a cross-national program for secondary students	N=141 Secondary school students, 13 to 17 years of age Four countries New Zealand, China, Norway and United States	Pre and post quasi ex	Pre and post interviews of 8week program	Knowledge of science as a way of knowing (NOS) **Invalid source specified.** Paper task (Goeschl & Perino, 2012)	no	Increase in recycling behaviours Significant increase in language use related to evidence-based reasoning Greater understanding of climate change and climate change science	Recycling
24	**Invalid source specified.**	Environmental Education for Behaviour Change: Which actions should be targeted?	N=134 Aged 14 years UK		Quantitative Questionnaire	Self-made questionnaire ANCOVA			

25	(Deisenrieder , Kubisch, Keller, & Stötter, Bridging the action gap by democratizing climate change education-The case of k.i.d.Z.21 in the context of Fridays for Future, 2020)	Bridging the Action Gap by Democratizing Climate Change Education—The Case of *k.i.d.Z.21* in the Context of Fridays for Future	N=169 11- to 16-year-old students South Germany and Austria	Correlational	Pre and post test after one school year of intervention and interviews	Pre and post-test questionnaires scientifically and validated using questionnaire software and evaluated quantitatively by IBM SPSS Statistics 25. Interviews were analysed by structured content analysis **Invalid source specified.Invalid source specified.**, for the attitude and patterns of argumentation, using the software MAXQDA 2018	Those who participated in Fridays (n-53) and those who did no participate (n-116)	Democratic learning both in and out of school can enhance action related components of climate change awareness. A combination of in school and out of school climate change learning has a stronger effect. interviewed students also clearly assigned increased action-related components of climate change awareness to the attendance of FFF. From the findings, we conclude that democratic learning in and out of school can enhance action-related components of climate change awareness, and a combination of both can have an even stronger effect	Refusing car rides and using public transport or bikes Not eating meat
26	(Eggert, Nitsch, Boone, Nuckles, & Bogeholz, 2017)	Supporting Students' Learning and Socioscientific Reasoning About Climate Change—the Effect of Computer-Based Concept Mapping Scaffolds	N=158 Last two years of high school students Mean age of 17.16		Pre and Post-test after 90-minute intervention	Factual Knowledge test Students learning outcomes, reasoning and decision making were tested using Rasch Partial Credit Model		Not relevant study as it focuses on computer skills rather than climate change	

27	(Flora, et al., 2014)	Evaluation of a national high school entertainment education program: The Alliance for Climate Education	N=1241 Students of all high school years participated USA		Pre and post surveys	Global warming six Americas screening tool **Invalid source specified.**		A improvement in students knowledge of climate science. There was positive engagement and improvement in climate related behaviours in the short term. Discussion continued at home and with peers after the intervention. An increase to 60% from 45% agreed that global warming is happening after the intervention.	Recycling Taking shorter showers Turning of flights Unplugging electric devices
28	(Cordero, Centeno, & Todd, 2020)	The role of climate change education on individual lifetime carbon emissions	N=500 Third Level students 5 years after completing module n university USA		Surveys and focus groups 5 years on from intervention	18item survey instrument was used to measure students' beliefs about climate change and their personal actions to mitigate it after taking the course as an intervention. The survey was based on questions found in **Invalid source specified. Invalid source specified.**		Students stated that taking the course had impacted hem both professionally and personally. Influences the food they eat and the type of car they drive.	It impacted waste decisions, home energy, transportation. A reduction in carbon emissions.
29	(Hu & Chen, 2016)	Place-based inter-generational communication on local climate improves adolescents' perceptions and willingness to	N=1229 Primary school China Ages 10 to 13 years		Mixed methods pre and post surveys and control group	Measuring a range of perceptions associated with climate change, related behavioural intentions using a modified model of TPB.		The senior participants of the study had noticed climate change variations. Adolescents interest in climate change which influenced and increased their climate mitigation intentions.	

		mitigate climate change	N=167 seniors mean age 63 years						
30	(Jackson & Pang, 2017)	Secondary school students' views of climate change in Hong Kong	N=1383 Secondary school students Hong Kong		Survey and semi structured interviews	New ecological Paradigm (NEP) (Dunlap, The New Environmental Paradigm Scale: From marginality to worldwide use, 2008) which measures climate change and other environmental attitudes using a Likert scale.		Younger students had less of an awareness of environmental and climate change issues. Students surveyed who attended international schools reported a wider variety of environmental behaviours. Teachers wo used enquiry teaching was more effective that didactic teaching.	Recycling Reducing energy waste Vegan diet Encouraging school to introduce thermal energy generator
31	(Lehnert, Fiedor, Frajer, Hercik, & Jurek, 2019)	Czech students and mitigation of global warming: beliefs and willingness to take action	N=1220 Upper primary students aged 14-15 years Final grades of secondary school 18-19 years Czech Republic		Questionnaire	Questionnaire designed on beliefs and willingness to act proposed by **Invalid source specified.**		Direct actions which were considered to be useful by the students were transport, choosing a smaller car with less fuel consumption. Reducing meat intake was not considered as useful for global warming Czech student are on average more sceptical on ways to tackle global warming. Measures relating to transport and renewable energy as most efficient actions.	More willing to switch off unnecessary electrical devices Willing to recycle more

32	**Invalid source specified.**	The Effect of Environmental Values on German Primary School Students' Knowledge on Water Supply	N=136 3rd to 4th graders, mean age 9.3 years Germany	Quasi experimental	Pre and post and retention questionnaire	Cronbach's alpha scores			
No.	**Author and date**	**Title**	**Participant details / Number of participants**	**Type of Study**	**Intervention**	**Measures**	**Comparator**	**Main Findings**	**Environmental behaviours**
33	(Parant, Pascaul, Jugel, Kerroume, & Gueguen, 2017)	Raising Students Awareness to Climate Change: An Illustration With Binding Communication	Middle school students (55% female) mean age= 16 From 4 schools in France	Quasi experimental 6 experimental and 6 control groups	Film and education about CC followed by questionnaire and binding communication	Multilevel generalised linear models (correlational?)	yes	The DVs – knowledge, attitude and behaviour change Knowledge increased in both groups – attitudes towards climate change increased more in exp group Participants in exp group were 4 times more likely to give their email to receive a carbon footprint tool	Willing ness to engage with measuring their carbon footprint when it is left up to them
37	(Robelia, Greenhow, & Burton, 2011)	Environmental learning in online social networks: adopting environmentally responsible behaviour	111 participants aged between 16-18 took part in survey	Quasi experimental mixed methods	Survey followed by focus group followed by post survey	Doesn't say	General pop	Free choice learning and participating in community of like-minded people is key	
38	(Wen & Lu, 2013)	Marine environmental protection knowledge, attitudes, behaviours, and	614 primary school (6th class) students from Taiwan	Research questionnaire	Correlational	– linear regression and t test to analyse difference in behaviours of high and low level knowledge	no	Attitudes can only predict 2% of the behaviours that are protective of environment	Marine protection

		curricular involvement of Taiwanese primary school students in senior grades		desig n				Field trip predicts more (5%) than classroom based (1%) for curricular involvement Knowledge and attitudes are not as influential on behaviours as thought	
40	Duerden, m & Witt, P (2010)	The impact of direct and indirect experiences on the development of environmental knowledge, attitudes, and behaviour	Middle school students mean age = 14.5	Mixe d meth ods desig n Contr ol group	Pre and post tests and questionnaire	One-way anovas conducted Also, qualitative data collected	yes	Direct experience involving environment more effective than indirect experience	Self-reported Environmental behaviour, knowledge and attitudes increased more during direct experience (nature)
41	(Vazquez-Vilchez, Garrido-Rosales, Perez-Fernandez, & Fernandez-Oliveras, 2021)	Using a Cooperative Educational Game to Promote Pro-Environmental Engagement in Future Teachers	128 teachers (age range 20-25) Spain	Mixe d meth ods surve y based	Qualitative and survey based		no	Based on global change rather than climate change but participants were able to identify much better 24% of students who played the game showed behavioural engagement	
42	(Brumann, Ohl, & Schulz, 2022)	Inquiry-Based Learning on Climate Change in Upper Secondary Education: A Design-Based Approach	433 students Upper secondary students	qualit ative	Qualitative	Focus groups			

43	(Monus, 2022)	Environmental education policy of schools and socioeconomic background affect environmental attitudes and pro-environmental behaviour of secondary school students	897 students in 14 secondary schools Comparison between 14year old and 18-year-old students		Survey using 52 items on a Likert scale and 11 multiple choice items on environmental concern, attitude behaviour	ANOVAs calculated based on 6 factors Correlations calculated to see what predicts what – grade, socioeconomic, gender	Yes – eco school non eco school	A school being a green school or not didn't impact behaviour Conservation behaviour increased if school heavily focused on it Older students have better attitudes and behaviours than first years	Responsible consumer behaviour Responsible food related habits Integration of EE programme into school
44	(Zsóka, Szerényi, Szechy, & Kocsis, 2013)	Greening due to environmental education? Environmental knowledge, attitudes, consumer behaviour and everyday pro-environmental activities of Hungarian high school and university students	770 high school students 2998 university Hungary	Correlational	Survey	MDS modelling	High school v uni	how strong is the relationship between environmental education and the knowledge, attitudes and actual behaviours uni students see consumption as issue not high schools students sources of information media, themselves school last uni students more environmentally conscious than high school	an increase in knowledge and the creation of better framework conditions could have a positive effect on the behaviour of students
45	(Manoli, et al., 2014)	Evaluating the impact of the Earthkeepers Earth education program on children's ecological understandings,	491 children aged 9 to 14	Mixed methods	4 instruments measuring Ecological concepts values understanding behaviour	Test before and after three day programme and one month after A pair-sample t-test analysis of the ECQ and 2-MEV scores helped determine if there	no	Increase in pro environmental values after the CCEP	Students who earned the Y key in game used less energy and fewer materials kept in close contact with earth

		values and attitudes, and behaviour in Cyprus				were any statistically significant changes in students' understanding of ecological concepts and environmental values and attitudes between pre- and post-program scores.			Also energy saving actions water saving actions
46	(Ali Khan, Karpudewan, & Annamalai, 2021)	Moving Beyond the One-Size-Fits-All Model in Describing the Climate Conserving Behaviours of Malaysian Secondary Students	221 participants 14-year-old Malaysians	Correlational	Survey based	PLS-SEM	no	knowledge ($\beta = 0.259$, $p < 0.05$), belief ($\beta = 0.295$, $p < 0.05$) and motivation ($\beta = 0.546$, $p < 0.05$) positively affects the behaviour. These findings reflected that knowledge, belief and motivation collectively explain a total of 65.5% of variances in the formation of climate conserving behaviour	
47	(van de Wetering, Leijten, Spitzer, & Thomaes, 2022)	Does environmental education benefit environmental outcomes in children and adolescents? A meta-analysis	Meta analysis of children and adolescents 169 studies (512 effect sizes; 176,007 participants) conducted in 43 countries					. Environmental education significantly improved environmental knowledge ($g = 0.953$), attitudes ($g = 0.384$), intentions ($g = 0.256$), and—mostly self-reported—behaviour ($g = 0.410$)	

48	(Yang, Wu, Tong, & Sun, 2022)	Narrative-Based Environmental Education Improves Environmental Awareness and Environmental Attitudes in Children Aged 6–8	143 participants in second grade of elementary school	Quasi experiment al	The students in the narrative group received normal teaching at school and watched seven short environmental education videos,		yes	environmental knowledge score was significantly higher the pro-environmental behaviour intention score did not differ significantly and the environmental attitude score did not significantly differ	Knowledge only
49	(Chen, 2019)	Transforming Environmental Values for a Younger Generation in Taiwan: A Participatory Action Approach to Curriculum Design	223 students 18-22	Quasi	4 parts pre and post q with thematic discussions and environmental work			Various attitudes and behaviour y the end of the semester, more students appear to believe that the sustainability problems are not too complex to be resolved changes 'Nature-based partnership learning' is the preferred future for students	Outdoor experience is a catalyst for the desire to learn more about nature The capacity for creating new ecological futures requires a that change be considered possible — that students have agency, and that good futures can be created.
51	(Bergman, 2016)	Assessing impacts of locally designed environmental education projects on students' environmental attitudes,	A total of 432 students from grades four to eight took the pre-survey Respondents to both the pre- and post-surveys	Experiment al	Pre and post test	Factor analysis	yes	Two of three student cohorts displayed increased *eco-impact awareness* over the course of one school year. EE students did not gain *eco-appreciation* or *intentions for eco-learning and behaviour* over one school year, but began the	

		awareness, and intention to act	included students from grades four, five, and seven who were engaged in EE sponsored by LSSI, and a fourth-grade comparison group. The comparison group was not involved in outdoor EE and studied a standard science curriculum					study with a positive orientation on both factors.	
52	(Alexander & Poyyamoli, 2017)	Climate change education for school students-activity-based teaching learning approach to create knowledge, attitudes skills and behavioural change	180 from two schools 45 in each school in control and experimental	quasi	Pre and post test		Yes	multiple teaching, learning approach is more effective among school children	
53	(Ronaghi, 2022)	**The effect of virtual reality technology and education on sustainable behavior: a comparative quasi-experimental study**	105 students 2 experimental groups one control	Quasi	Pre-test post test G1 training course and VR G2VR courseG3 Control got trad training		yes	Using VR together with a training course has an effect on sustainable behaviour where trad course didn't and VR on its own didn't	

54	(Cordero, Centeno, & Todd, 2020)	**The role of climate change education on individual lifetime carbon emissions**	104 First year uni students	Correlational and focus groups	Survey	Correlational survey and	no	Reduction in annual carbon emissions by 3tons	Reduction in annual carbon emissions by 3tons
55	(Kovács, Medvés , & Pántya, 2020)	**The relationship between environmental knowledge of preteens and their choice among plastic and non-plastic materials for a manual task**	325 Students 10-112	Quasi experimental	Pre and post test	Kruskal-Wallis probes since none of the variables were distributed normally (according to the Kolmogorov-Smirnov probes)	yes	positive connection between knowledge and self-reported behaviour was fully mediated by environmental attitudes, know-ledge was just slightly related to actual behaviour, even when the topic of environmentalism appeared before the behaviour choice. However, behaviour was related to school, suggesting that school-level socialization (beyond the knowledge transfer) is highly influential in forming environ-mental behaviour.	Use this paper for write up! All about behaviour
56	(Muhlisin, Rosiana, Rahayuningsih, & Suharyana, 2019)	**The Efforts to Improve Environmental Behavior and Critical Thinking of Students through Guided Inquiry-Based Learning on Environmental Education-Based Science**	35 student's 3rd year Indonesia 15 years	Quasi experimental	Not stated	2 cycles of learning – no results in first cycle and results in second	no	guided inquiry learning in science can increase environmental behaviour and critical thinking of students	

57	(Berglund, Gericke, & Change-Rundgren, 2014)	**The implementation of education for sustainable development in Sweden: investigating the sustainability consciousness among upper secondary students**	638 students grade 12 (17 years old)	experimental	Questionnaire on knowledge, attitudes and behaviours	2 groups one from ESD schools, the other not	yes	results show that ESD-profiled schools have effect on students' SC, the effects are relatively small According to Giddings, Hopwood, and O'Brien (2002Giddings, B., B. Hopwood, and G. O'Brien. 2002. the economy is often prioritized at a political level and hence often a dominating perspective when it comes to decision-making, while the environment sets material boundaries to human activities.	Sustainability consciousness difference between schools was negligible – biospheric knowledge
58	(Johnson & Činčera, 2021)	**Relationships between outdoor environmental education program characteristics and children's environmental values and behaviours**	325 pre and post 278 in delay 3rd to 6th grade students (primary aged)	Quasi experimental	Questionnaire pre and post and delay Correlational	Only one group participating Used confirmatory factor analyses	no	Environmental values have an effect on how well any environmental education can be	
59	(Nourmoradi, Asadi, Mehdi-Naghizade	**The influence of an education program on**	330 girls First to third year	Experimental	Two group control and experimental		yes	students in the intervention group felt more responsible than the control group for saving water and	Recycling, water, and energy conservation

	h, Mazloomi, & Ghazanfari, The influence of an education program on students' environmental responsibility in developing countries: evidence from Iran, 2021)	**students' environmental responsibility in developing countries: evidence from Iran**	11-15 years old Iran					heating energy and proper waste management (recycling and disposal) of the school's environment	
60	(Zografakis, Menegaki, & Tsagarakis, 2008)	Effective education for energy efficiency	321 students of all ages Parents also	Experimental	Questionnaire responses	Use paired samples pre and post to id stat sig results	no	statistically significant in all energy behaviour questions related to students and to most questions related to parents	Energy use and energy thrift
61	(Gottlieb, Vigoda-Gadot, & Haim, Encouraging ecological behaviors among students by using the ecological footprint as	**Encouraging ecological behaviors among students by using the ecological footprint as an educational tool: a quasi-experimental design in a public high**	130 70 control 10th grade (16-17yearolds)	Quasi experimental	Questionnaire		yes	Consideration of ecological footprint of the school	

	an educational tool: a quasi-experimental design in a public high school in the city of Haifa, 2013)	**school in the city of Haifa**							

References

Nongqayi, L., Risenga, I., & Dukhan, S. (2022). Youth's knowledge and awareness of human contribution to climate change: the influence of social and cultural contexts within a developing country. *Educational and Development Psychologist, 39*, 44-57. Retrieved from 10.1080/20590776.2022.2050461

Agirreazkuenaga, L., & Martinez, P. (2021). Secondary school student's perception, positioning and insight on education for sustainabilitity. *International research in geographical andenvironmental education, 30*, 218-237. Retrieved from https://doi.org/10.1080/10382046.2021.1877952

Ajzen, I. (1991). The theory of planned behaviour. *Organizational Behavior and Human Decision Process, 50*(2), 179-211. doi:https://doi.org/10.1016/0749-5978(91)90020-T

Alexander, R., & Poyyamoli, G. (2017). Climate change education for school students-activity-based teaching learning approach to create knowledge, attitudes skills and behavioural change. *International Journal of Global Warming, 12*(3-4), 431-447. doi:10.1504/IJGW.2017.10005894

Ali Khan, N., Karpudewan, M., & Annamalai, N. (2021). Moving beyond the one size fits all model in describing the climate conserving behaviors of Malaysian scondary students. *Sustainability, 13*(18), 1-20. Retrieved from https://dx.doi.org/10.3390/su13010018

ALLEA. (2020). *A snapshot of climate change education initiatives in Europe: Some initial findings and implications for future climate change education research.* Berlin: ALLEA. doi:10.26356/climateeducation

An Taisce. (2016). *Green-schools programme.* Dublin: An Taisce Environmental Education Unit. Retrieved October 5, 2022, from https://greenschoolsireland.org/wp-content/uploads/2016/09/General-Handbook.pdf

Anderson, A. (2012). Climate Change Education for Mitigation and Adaptation. *Journal of Education for Sustainable Development, 6*(2), 191-206. doi:10.1177/0973408212475199

Anderson, A. (2013). Climate change education for mitigation and adaptation. *Journal of Education for Sustainable Development, 6*(2), 191-206. doi:10.1177/0973408212475199

APA. (2017). *Mental health and our changing climate.* Washington DC: American Psychological Association.

Appelbaum, N., Santen, S., Vota, S., Wingfield, L., Sabo, R., & Yaghmour, N. (2019). Threats to reliability and validity withr esident welness surveying efforts. *Journal of Graduate Medical Education, 11*(5), 543-549. doi:10.4300/JGME-D-19-00216.1

Ardoin, N., Bowers, A., Roth, N., & Holthuis, N. (2018). Environmental education and K-12 outcomes: A review and analysis of research. *The Journal of Environmnetal Education, 49*(1), 1-17. doi:https://doi.org/10.1080/00958964.2017.1366155

Armson, R. (2011). Drawing Rich Pictures. In R. Armson, *Growing wings on the way: Systems thinking for messy situations* (pp. 57-77). Axminster: Triarchypress.

Arya, D., & Maul, A. (2016). The building of knowledge, language, and decision-making about climate change science: a cross-national program for secondary students. *International Journal of Science Education, 38*(6), 885-904. doi:10.1080/09500693.2016.1170227

Axelrod, L., & Lehman, D. (1993). Responding to environmental concern: What factors guide individual action? *Journal of Environmental Psychology, 13*(2), 149-159. doi:10.1016/S0272-4944(05)80147-1

Azjen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behaviour.* Englewood Cliffs: Prentice-Hall.

Baierl, T. M., Kaiser, F. G., & Bogner, F. X. (2022). The supportive role of environmental attitude for learning about enviornmental issues. *Journal of Environmental Psychology, 81*, 1-11. doi:10.1016/j.jenvp.2022.101799

Balgopal, M., Klein, J., Brown, C., Sample McMeeking, L., Morgan, J., & Marshall Frasier, w. (2014). Linking biophysical, socioeconomic, and political effects of climate change on agro-ecosystems. *Journal of Geoscience Education, 62*(3), 343-353. Retrieved from https://www.proquest.com/docview/1564036917/fulltextPDF/F21593ECCDD8470FPQ/1?accountid=55804

Balunde, A., Perlaviciute, G., & Steg, L. (2019). The relationship between people's environmental considerations and pro-environmental behavior in Lithuania. *Frontiers in Psychology, 10*. doi:10.3389/fpsyg.2019.02319

Balunde, A., Perlaviciute, G., & Truskauskaite-Kuneviciene, I. (2020). Sustainability in Youth: Environmental Considerations in Adolescence and Their Relationship to Pro-environmental Behavior. *Frontiers in Psychology*. Retrieved from https://doi.org/10.3389/fpsyg.2020.582920

Bamberg, S., & Moser, G. (2007). Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmnetal behaviour. *Journal of Environmental Psychology, 27*(1), 14-25. doi:10.1016/j.jenvp.2006.12.002

Barker, C., Pistrang, N., & Elliott, R. (2002). *Research methods in clinical psychology: An introduction for students and practitioners* (2nd ed.). Chicester: John Wiley & Sons.

Barry, A. (2005). How attrition impacts the internal and external validity of longitudinal research. *Journal of School Health, 75*(7), 267-270. doi:10.1111/j.1746-1561.2005.00035.x

Barton, H., & Grant, M. (2006). A health map for the local human habitat. *The Journal of the Royal Society for the Promotion of Health, 126*(6), 252-261. doi:doi.org/10.1177%2F1466424006070466

Berglund, T., Gericke, N., & Change-Rundgren, S. (2014). The implementation of education for sustainable development in Sweden: investigating the sustainability consciousness among upper secondary students. *Research in Science and Technological Education, 32*(3), 318-339. doi:10.1080/02635143.2014.944493

Bergman, B. G. (2016). Assessing impacts of locally designed environmental education projects on students' environmental attitudes, awareness, and intention to act. *Environmental Education Research, 22*(4), 480-503. doi:https://doi.org/10.1080/13504622.2014.999225

Bernstein, J., & Szuster, B. (2019). The new environmental paradigm scale: Reassessing the operationalization of contemporary environmentalism. *The Journal of Environmental Education, 50*(2), 73-83. doi:10.1080/00958964.2018.1512946

Bodzin, A., & Qiong, F. (2014). The effectiveness of the geospatial curriculum approach on urban middle level students' climate change understandings. *Journal of Science Education & Technology, 23*(4), 575-590. doi:10.1007/s10956-013-9478-0

Boeve-de Pauw, J., Donche, V., & Van Petegem, P. (2011). Adolescents' environmental worldview and personality: An explorative study. *Journal of Environmental Psychology, 31*, 109-117. doi:10.1016/j.jenvp.2010.05.003

Bofferding, L., & Kloser, M. (2015). Middle and high school students conceptions of climate change mitigation and adaption strategies. *Environmental Education Research, 21*(2), 275-294. doi:http://dx.doi.org/10.1080/13504622.2014.888401

Bofferding, L., & Kloser, M. (2015). Middle and high school students' conceptions of climate change mitigation and adaptation strategies. *Environmental Education Research, 21*(2), 275-294. doi:10.1080/13504622.2014.888401

Bogner, F., & Wiseman, M. (2006). Adolescent's attitudes towards nature and environment. *Environmentalist, 26*, 231-237. doi:https://doi.org/10.1007/s10669-006-8660-9

Boland, L. (2022, January 29). *'Dismal' and 'inadequate' climate education must be tackled, students and teachers say.* Retrieved from thejournal.ie: https://www.thejournal.ie/climate-education-strategy-schools-5667296-Jan2022/

Bouman, T., Steg, L., & Kiers, H. (2018). Measuring Values in Environmental Research: A Test of an Environmental Portrait Value Questionnaire. *Personality and Social Psychology, 9*, 1-15. doi:https://doi.org/10.3389/fpsyg.2018.00564

Bourdieu, P. (1977). *Outline of a theory of practice.* Cambridge: Cambridge University Press.

Boyes, E., & Stanisstreet, M. (2011). Environmental education for behaviour change: Which actions should be targeted? *International Journal of Science Education, 34*(12), 1591-1614. doi:10.1080/09500693.2011.584079

Boyes, E., Skamp, K., & Stanisstreet, M. (2009). Australian secondary students' views about global warming: beliefs about actions, and willingness to act. *Research in Science Education, 39*, 661-680. doi:https://doi.org/10.1007/s11165-008-9098-5

Boys, A., Marsden, J., Stillwell, G., Hatchings, K., Griffiths, P., & Farrell, M. (2003). Minimising respondent attrition in longitudinal research: practical implications from a cohort study of adolescent drinking. *Journal of Adolescence, 26*(3), 363-373. doi:10.1016/s0140-1971(03)00011-3

Bracken, S. (2010). Discussing the importance of ontology and epistemology awareness in practitioner research. *Worcester Journal of Learning and Teaching, 4*, 1-9. Retrieved from https://eprints.worc.ac.uk/843/1/FinalSBrackenPractitionerResearch.pdf

Bratman, G. N., Olvera-Alvarez, H., & Gross, J. J. (2021). The affective benefits of nature exposure. *Social and Personality Psychology Compass, 15*(8). doi:https://doi-org.libraryproxy.mic.ul.ie/10.1111/spc3.12630

Brumann, S., Ohl, U., & Schulz, J. (2022). Inquiry-based Learning on climate change in upper secondary education: A design based approach. *Sustainability, 14*, 1-29. doi:10.3390/su14063544

Burgland, T., Gericke, N., & Chang-Rundgren, S. (2014). The implementation of education for sustainable development in Sweden: investigating the sustainability consciousness among upper secondary students. *Research in Science & Technological Education, 32*(3), 318-339. doi:https://doi-org.libraryproxy.mic.ul.ie/10.1080/02635143.2014.944493

Carr, A. (2016). *The handbook of clinical and adolescent psychology: A contextual approach* (3rd ed.). London: Routledge.

Cebrian, G., Pascual, D., & Moraleda, A. (2019). Perception of sustainability competencies amongst Spanish pre-service secondary school teachers. *International Journal of Sustainability in Higher Education, 20*(7), 1171-1190. doi:http://dx.doi.org/10.1108/IJSHE-10-2018-0168

Checkland, P., & Poulter, J. (2006). *Learning for Action: A short definitive account of soft systems methodology and its use for practitioners, teachers and students.* Chichester: John Wiley and Sons Ltd.

Chen, K. H. (2019). Transforming environmental values for a younger generation in Taiwan: A participatory Action Approach to Curriculum Design. *Journal of Future Studies, 23*(4), 79-96. doi:10.6531/JFS.201906_23(4).0008

Choy, E. (2014, August). *Body Earth Metaphor Workshop.* Retrieved from Movement Generation: https://movementgeneration.org/wp-content/uploads/2014/08/Body-Earth-Metaphor-2014.pdf

Clayton, S., Manning, C., Speiser, M., & Hill, A. (2021). *Mental health and out changing climate: impacts, inequities, responses* (2nd ed.). Washington DC: American Psychological Association and ecoAmerica. Retrieved from https://www.apa.org/news/press/releases/mental-health-climate-change.pdf

Cohen, J. (1992). A power primer. *Psychological Bulletin*, 1304-1312. doi:10.1037//0033-2909.112.1.155

Collado, S., Staats, H., & Corraliza, J. (2013). Experiencing nature in children's summer camps: Affective, cognitive and behavioral consequences. *Journal of Environmental Psychology, 33*, 37-44. Retrieved from https://doi.org/10.1016/j.jenvp.2012.08.002

Cordero, E., Centeno, D., & Todd, A. M. (2020). The role of climate change education on individual lifetime carbon emissions. *PloS ONE, 15*(2), 1-23. doi:10.1371/journal.pone.0206266

Corral-Verdugo, V. (1997). Dul 'realities of conservation behaviour: Self reports versus observations of re-use and recycling behaviour. *Journal of Environmental Psychology, 17*, 135-145. Retrieved from https://doi.org/10.1006/jevp.1997.0048

Costello, A., Abbas, M., Allen, A., Ball, S., Bell, S., Bellamy, R., . . . Patterson, C. (2009). Managing the health effects of climate change. *The Lancet Commissions, 373*(9676), 1693-1733. doi:https://doi.org/10.1016/S0140-6736(09)60935-1

Crocetti, E., Rubini, M., Luyckx, K., & Meeus, W. (2007). Identity formation in early and middle adolescents from various ethnic groups: From three dimensions to five statuses. *journal of Youth and Adolescence, 37*, 983-996. doi:10.1007/s10964-007-9222-2

Crotty, M. (1998). *The foundations of social research: meaning and perspective in the research process.* London: Sage.

CSO. (2021). *Environmental Indicators in Ireland.* Retrieved from Central Statistics Office : https://www.cso.ie/en/releasesandpublications/ep/p-eii/environmentalindicatorsireland2021/mainfindings/

Damerell, P., Howe, C., & Milner-Gulland, E. J. (2013). Child-orientated environmental education influences adult knowledge and household behaviour. *Environmental Research, 8*(1), 1-8. Retrieved from 10.1088/1748-9326/8/1/015016

Davis, A., & Stroink, M. (2015). The relationship between systemes thinking and the New Ecological Paradigm. *Systems Research and Behavioural Science, 33*(4), 575-586. Retrieved from https://doi-org.libraryproxy.mic.ul.ie/10.1002/sres.2371

Dawson, V. (2015). Western Australian high school students' understandings about the socioscientific issue of climate change. *International Journal of Science Education, 37*, 1024-1043. doi:https://doi-org.libraryproxy.mic.ul.ie/10.1080/09500693.2015.1015181

de Groot, J., & Steg, L. (2007). Value orientations to explain beliefs related to environmnetal significant behaviour: how to measure egoistic, alotruistic and biospheric value orientations. *Environmental Behaviour, 40*, 330-354. doi:10.1177/0013916506297831

deGroot, J., & Steg, L. (2007). General beliefs and the theory of planned behaviour: The role of environmental concerns in the TPB. *Journal of Applied Social Psychology, 37*(8), 1817-1836.

Deisenrieder , V., Kubisch, S., Keller, L., & Stötter, J. (2020). Bridging the action gap by democratizing climate change education-The case of k.i.d.Z.21 in the context of Fridays for Future. *Sustainability , 12*, 1-19. doi:10.3390/su12051748

Deisenrieder, V., Kubisch, S., Keller, L., & Stötter, J. (2020). Bridging the action gap by democratizing climate change education-The case of k.i.d.Z.21 in the context of Fridays for Future. *Sustainability, 12*, 1-19. doi:10.3390/su12051748

Department of Education and Skills. (2016). *School self-evaluation guidelines 2016-2020.* Dublin: Department of Education and Skills. Retrieved from https://www.gov.ie/en/publication/5c47a7-school-self-evaluation-guidelines/

Department of the Environment, Climate and Communications. (2021, July). *Government approves landmark Climate Bill putting Ireland on the path to net-zero emissions by 2050.* Retrieved from gov.ie: https://www.gov.ie/en/press-release/22e97-government-approves-landmark-climate-bill-putting-ireland-on-the-path-to-net-zero-emissions-by-2050/

Dept of Communications, Climate Action and Environment. (2019). *Climate Action Plan.* Dublin: Government of Ireland. Retrieved from https://assets.gov.ie/25419/c97cdecddf8c49ab976e773d4e11e515.pdf

Dept of Education. (2022). *Looking at Our School 2022: A quality framework for post-primary schools.* Dublin: Department of Education. Retrieved from https://www.gov.ie/en/publication/b1bb3-looking-at-our-school-2022/

Dept of Education and Skills. (2014). *Education for Sustainability : The National Strategy on Education for Sustainable Development in Ireland, 2014-2020.* Dublin: Dept of Education and Skills. Retrieved from http://www.unesco.org/education/edurights/media/docs/a0b5b82b0e14b72030246935ad6a1bf914f158bc.pdf

Dept of the Environment, Climate and Communications. (2021). *Climate Action Plan 2021: Securing our Future.* Dublin: Government of Ireland, Department of the Environment, Climate and Communications. Retrieved July 11th , 2022, from https://assets.gov.ie/224574/be2fecb2-2fb7-450e-9f5f-24204c9c9fbf.pdf

DES. (2014). *The national strategy on education for ssutainable development in Ireland, 2014-2020.* Dublin: Department of Education and Skills. Retrieved from file:///C:/Users/35387/Downloads/70926_7e8f9ccf9069441e960d7f32a38dc7b9.pdf

DES. (2015). *Framework for Junior Cycle.* Dublin: Ireland: Department of Education and Skills. Retrieved 18 10, 2022, from https://ncca.ie/media/3249/framework-for-junior-cycle-2015-en.pdf

Dhanapal, S., & Lim, C. (2013). A comparative study of the impacts and students' perceptions of indoor and outdoor learning in the science classroom. *Asia-Pacific Forum on Science Learning and Teaching, 14*(2), 1-23. Retrieved from http://libraryproxy.mic.ul.ie/login?url=https://www.proquest.com/scholarly-journals/comparative-study-impacts-students-perceptions/docview/1955901936/se-2.

Dietz, T., Gardner, G., Gilligan, J., Stern, P., & Vandenbergh, M. (2009). Household actions can provide a behavioral wedge to rapidly reduce US carbon emissions. *PNAS, 106*(44), 18452-18456. doi:https://doi.org/10.1073/pnas.0908738106

Dolan, A. (2022). *Teaching climate change in primary schools.* Dublin: Routledge.

Duerden, M., & Witt, P. (2010). The impact of direct and indirect experiences on the development of environmental knowledge, attitudes, and behavior. *Journal of Environmental Psychology, 30*(4), 379-392. doi: Mat D. Duerden; Peter A. Witt (2010). The impact of direct and indirect experiences on the develodoi:10.1016/j.jenvp.2010.03.007

Dunlap, R. (2008). The New Environmental Paradigm Scale: From marginality to worldwide use. *Journal of Environmental Education, 40*(1), 3-18. doi:10.3200/JOEE.40.1.3-18

Dunlap, R., Van Liere, K., Mertig, A., & Jones, R. (2000). Measuring endorsement of the new ecological paradigm: A revised NEP scale. *Journal of Social Issues, 56*(3), 425-442. doi: https://doi.org/10.1111/0022-4537.00176

Duvall, J., & Zint, M. (2007). A review of research on the effectiveness of environmnetal education in promoting intergenerational learning. *The Journal of Environmental Education, 38*(4), 14-24. doi:10.3200/JOEE.38.4.14-24

ECO UNESCO. (2010). *Youth for the Future: Creating a sustainable world.* Dublin: ECO UNESCO. Retrieved from https://issuu.com/ecounesco/docs/youth_for_the_future_resource

Eggert, S., Nitsch, A., Boone, W., Nuckles, M., & Bogeholz, S. (2017). Supporting students learning and socioscientific reasoning about climate chnage- the effect of computer-based concept mapping scaffolds. *Research in Science Education, 47*, 137-159. doi:10.1007/s11165-015-9493-7

Environmental Protection Agency. (2019). *Where are Ireland's emissions coming from?* Retrieved from EPA: https://www.epa.ie/media/epa-2020/monitoring-amp-assessment/climate-change/Ireland%C3%A2%C2%80%C2%99s_GHG_emissions_sources_and_solutions.pdf

EPA. (2022, June). *Greenhouse gas emissions and projections - Key messages.* Retrieved from Environmental Protection Agency: https://www.epa.ie/our-services/monitoring--assessment/climate-change/ghg/key-messages/

EPA. (2022, June). *Latest Emissions Data.* Retrieved from Environmental Protection Agency: https://www.epa.ie/our-services/monitoring--assessment/climate-change/ghg/latest-emissions-data/

Farrand, P., Hussain, F., & Hennessy, E. (2002). The efficacy of the 'mind map' study technique. *Medical Education, 36*, 426-431. doi:10.1046/j.1365-2923.2002.01205.x

Faul, F., Erdfelder, E., Buchner, A., & Lang, A. (2007). G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*(2), 175-191. doi:10.3758/bf03193146

Fehr-Duda, H., & Fehr, E. (2016). Sustainability: Game human nature. *Nature, 530*, 413-415. doi:https://doi.org/10.1038/530413a
Feinstein, N., & Mach, K. (2019). Three roles for education in climate change adaptation. *Climate Policy*, 1469-3062. doi:https://doi.org/10.1080/14693062.2019.1701975
Field, A. (2017). *Discovering Statistics using IBM SPSS statistics* (5th ed.). London: Sage.
Flora, J. A., Saphir, M., Lappé, M., Roser-Renouf, C., Maibach, E., & Leiserowitz, A. (2014). Evaluation of a national high school entertainment education program: The Alliance for Climate Education. *Climatic Change, 127*(3-4), 419-434. doi:10.1007/s10584-014-1274-1
Frankel, S., Sellmann-Risse, D., & Basten, M. (2019). Fourth graders' connectedness to nature - Does cultural background matter? *Journal opf Environmental Psychology, 66*, 1-7. doi:https://doi.org/10.1016/j.jenvp.2019.101347
Frick, J., Kaiser, F., & Wilson, M. (2004). Environmental knowledge and conservation behaviour: Exploring prevalence and structure in a representative sample. *Personality and Individual differences, 37*(8), 1597-1613. doi:http://dx.doi.org/10.1016/j.paid.2004.02.015
Fritze, J., Blashki, G., Burke, S., & Wiseman, J. (2008). Hope, despair and transformation: Climate change and the promotion of mental health and wellbeing. *International journal of mental health systems, 2*, 1-13. doi:10.1186/1752-4458-2-13
Gallagher, K. (2008). *The Methodological Dilemma: Creative, critical, collaborative and post-positivist .* London: Rutledge.
Gatersleben, B., Murtagh, N., & Abrahamse, W. (2014). Values, identity and pro-environmental behaviour. *Contemporary Social Science, 9*, 374-392. doi:10.1080/21582041.2012.682086
Goeschl, T., & Perino, G. (2012). instrument choice and motivation: Evidence from a climate change experiment. *Environmental Resources Economics, 52*, 195-212. doi:10.1007/s10640-011-9524-4
Gottlieb, D., Vigoda-Gadot, E., & Haim, A. (2013). Encouraging ecological behaviors among students by using the ecological footprint as an educational tool: a quasi-experimental design in a public high school in the city of Haifa. *Environmental Education Research, 19*(6), 844-863. doi:10.1080/13504622.2013.768602
Gottlieb, D., Vigoda-Gadot, E., & Haim, A. (2013). Encouraging ecological behaviors among students by using the ecological footprint as an educational tool: a quasi-experimental design in a public high school in the city of Haifa. *Environmental Education Research, 19*(6), 844-863. doi:10.1080/13504622.2013.768602
Gottlieb, D., Vigoda-Gadot, E., Haim, A., ., ,, & . (2013). Encouraging ecological behaviors among students by using the ecological footprint as an educational tool: a quasi-experimental design in a public high school in the city of Haifa. *Environmental Education Research, 19*(6), 844-863. doi:10.1080/13504622.2013.768602
Gough, D. (2007). Weight of Evidence: A framework for the appraisal of the quality and relvence of evidence. *Research Papers in Education, 22*(2), 213-228. doi:10.1080/02671520701296189
Government of Ireland. (2018). *Data Protection Act, 2018.* Retrieved from https://www.gov.ie/pdf/?file=https://assets.gov.ie/122558/49907c6f-a2e5-4c9e-8ee0-953315da668c.pdf#page=null
Government of Ireland. (2022). *2nd national strategy on education for sustainable development ESD to 2030.* Dublin: Govt of Ireland. Retrieved 10 13, 2022, from https://www.gov.ie/en/publication/02952d-national-strategy-on-education-for-sustainable-development-in-irelan/
Government of Ireland. (2022). *ESD to 2030: Implementation plan 2022-2026.* Dublin: Government of Ireland. Retrieved from https://www.gov.ie/en/publication/02952d-national-strategy-on-education-for-sustainable-development-in-irelan/
Gowdy, J. (2008). Behavioral economics and climate change policy. *Journal of Economic behavior and organisation, 68*(3-4), 632-644. doi:10.1016/j.jebo.2008.06.011
Griffin, P., Heede, R., & van Der Vlugt, I. (2017). *The Carbon Majors database.* Brussels: Carbon Disclosure Project. Retrieved from Sustainability for all: https://cdn.cdp.net/cdp-production/cms/reports/documents/000/002/327/original/Carbon-Majors-Report-2017.pdf?1501833772
Grønhøj, A., & Thøgersen, J. (2009). Like father, like son? Intergenerational transmission of values, attitudes, and behaviours in the environmental domain. *Journal of Environmental Psychology, 29*(4), 414-421. doi:10.1016/j.jenvp.2009.05.002

Grønhøj, A., & Thøgersen, J. (2012). Action speaks louder than words: The effect of personal attitudes and family norms on adolescents' pro-environmental behaviour. *Journal of Economic Psychology, 33*(1), 292-302. doi:10.1016/j.joep.2011.10.001

Hall, T., & Murray, B. (2010). *Universal Design for Learning.* Washington: TEAL. Retrieved from https://lincs.ed.gov/sites/default/files/2_TEAL_UDL.pdf

Han, H., Hsu, J., & Chwen, S. (2010). Application of the theory of planned behaviour to green hotel choice: Testing the effect of environmentally friendly activities. *Tourism Management, 31*(3), 325-334. doi:https://doi.org/10.1016/j.tourman.2009.03.013

Heberlein, T. (2012). *Navigating environmental attitudes.* New York: Oxford University Press.

Helm, D. (2011). Sustainable consumption, climate change and future generations. *Royal Institute of Philosophy, 69*, 235-252. doi: https://doi.org/10.1017/S1358246111000294

Hermans, M., & Korhonen, J. (2007). Ninth graders and climate change: Attitudes towards consequences, views on mitigation, and predictors of willingness to act. *International Research in Geographical and Environmental Education, 26*(3), 223-239. doi:https://doi.org/10.1080/10382046.2017.1330035

Hermans, M., & Korhonen, J. (n.d.). Ninth graders and climate change: Attitudes towards consequences, views on mitigation, and predictors of willingness to act. *NTERNATIONAL RESEARCH IN GEOGRAPHICAL AND ENVIRONMENTAL EDUCATION, 26*(3), 223-239. doi:https://doi.org/10.1080/10382046.2017.1330035

Hertwich, E. (2005). Life cycle approaches to sustainable consumption: A critical review. *Environmental science and technology, 39*(13), 4673-4684. doi:https://doi.org/10.1021/es0497375

Hertwich, E., & Peters, G. (2009). Carbon footprint of nations: A global, trade-linked analysis. *Environmental Science and Technology, 43*(16), 6414-6420. doi:https://doi.org/10.1021/es803496a

Hesse-Biber, C. (2019). The role of hybrid methodologies in understanding complex environmental issues and promoting social justice. *International Journal for Transformative Research, 6*(1), 20-26. doi:https://doi.org/10.1515/ijtr-2019-0004

Hicks, D. (2019). Education and Climate Change. In C. Simon, & S. Ward, *A student's guide to education studies.* London: Routledge.

Hines, J. (1987). Analysis and synthesis of research on responsible environmental behaviour: A meta-analysis. *Journal of Environmental Education, 18*(2), 1-8.

Hines, J., Hungerford, H., & Tomera, A. (1987). Analysis and synthesis of research on responsible environmental behaviour: A meta-analysis. *The Journal of Environmental Education, 18*(2), 1-8. doi:10.1080/00958964.1987.9943482

Hormio, S. (2017). Can corporations have (moral) responsibility regarding climate change mitigation. *Ethics, Policy and Environment, 20*(3), 314-332. doi:10.1080/21550085.2017.1374015

Howard-Jones, P., Sands, D., Dillon, J., & Fenton-Jones, F. (2021). The views of teachers in England on an action-oriented climate change curriculum. *Environmental Education Research, 27*(11), 1660-1680. doi:https://doi-org.libraryproxy.mic.ul.ie/10.1080/13504622.2021.1937576

Hu, S., & Chen, J. (2016). Place-based inter-generational communication on local climate improves adolescents' perceptions and willingness to mitigate climate change. *Climatic Change, 138*, 425-438. doi:10.1007/s10584-016-1746-6

Hungerford , H., & Volk, T. (1990). Changing learner behaviour through environmental education. *The Journal of Environmental Education, 21*, 8-21. doi:10.1080/00958964.1990.10753743

Hungerford, H. R. (1996). The development of responsible environmental citizenship: A critical challenge. *Journal of Interpretation Research, 1*(1), 25-37. doi: Hungerford, Harold R. (1996). The Development of Responsible Environmental Citizenship: 10.1177/109258729600100104

Hyman, E. (2020, January 2). *Who's really responsible for climate change?* Retrieved from Harvard Political Review: https://harvardpolitics.com/climate-change-responsibility/

Ignell, C., Davies, P., & Lundholm, C. (2019). A longitudinal study ofupper secondary school students' values and beliefs regarding policy responses to climate change,. *Environmental Education Research, 25*(6), 614-632. doi:https://doi.org/10.1080/13504622.2018.1523369

Ihlen, O. (2009). Business and climate change: The climate response of the world's 30 largest coroprations. *3*(2), 242-262. doi:10.1080/17524030902916632
IPCC. (2014). Summary for Policymakers. In IPCC, *Climate Change 2014: Mitigation of Climate Change.* Cambridge: Cambridge University Press. Retrieved from https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_summary-for-policymakers.pdf
IPCC. (2014). Summary for Policymakers. In IPCC, *Climate Change 2014: Impacts, adaptation and vulnerability.* Cambridge: Cambridge University Press. Retrieved from https://drive.google.com/file/d/1Auac2VSmsQ9DxVVs5oce-oq4-2zRP5jw/view?usp=sharing
IPCC. (2021). Climate Change 2021: Summary for Policymakers. In V. Masson-Delmotte, A. Zhai, S. Pirani, C. Connors, S. Péan, N. Berger, . . . B. Shou, *Climate Change 2021: The Physical Science Basis.* Cambridge: Cambridge University Press.
IPCC. (2022). IPCC 2022: Summary for policy makers. In D. R. H.-O. Pörtner, *Climate Change 2022: impacts, adaptation and vulnerability. Contribution of Working Group III to the Sixth Assessment Report of the intergovernmental panel on Climate Change* (pp. 3-33). Cambridge, UK: Cambridge University Press. doi:10.1017/9781009325844.001
IPCC. (2022). Summary for Policymakers. In J. S. P.R. Shukla, *Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (pp. 1-48). Cambridge UK: Cambridge University Press. doi:10.1017/9781009157926.001
IPCC. (2022). *Working Group III contribution to the sixth assesment repoert of the intergovernmenal panel on climate change.* Geneva: UNEP/IPCC. Retrieved July 11, 2022, from https://report.ipcc.ch/ar6wg3/pdf/IPCC_AR6_WGIII_FinalDraft_FullReport.pdf
Ismail, K. M., Ayub, A. F., & Subramanian, R. (2021). Effect of environmental education modul towards pupils knowledge and behaviour intention among primary pupils. *International Journal of Academic Research in Business and Social Sciences, 11*(7), 402-407. doi:10.6007/IJARBSS/v11-i7/9241
Jackson, L., & Pang, M. F. (2017). Secondary school students' views of climate change. *International research in geographical and environmental education*, 1-13. doi:10.1080/10382046.2017.1330036
Jackson, T. (2005). *Motivating sustainable consumption. A review of evidence on consumer behaviour and behavioural change.* Surrey: Centre for Environmental Strategy. Retrieved from http://www.sd-research.org.uk/wp-content/uploads/motivatingscfinal_000.pdf
Jennings, F. (2019). Where to turn? The influence of infomration source on belief and behavior. *Journal of Risk Research, 22*(2), 909-918. doi:10.1080/13669877.2017.1422788
Jensen, B. B. (2002). Knowledge, action and pro-environmental behaviour. *Environmental Education Research, 8*(3), 325-334. doi:http://dx.doi.org/10.1080/13504620220145474
Jensen, B. B., Schnack, K., & Simovska, V. (2000). *Critical environmental and health education: research issues and challenges.* Copenhagen: The Danish University of Education.
Jia, F., & Yu, H. (2021). Action, communication, and engagement: how parents "ACE" Children's pro-environmental behaviors. *Journal of Environmental Psychology, 74*, 1-9. doi:10.1016/j.jenvp.2021.101575
Jie Li, C., & Monroe, M. (2017). Exploring the essential psychological factors in fostering hope concerning climate change. *Environmnental Education Research, 25*, 936-954. doi:10.1080/13504622.2017.1367916
Johnson, B., & Činčera, J. (2021). Relationships between outdoor environmental education program characteristics and children's environmental values and behaviors. *Journal of Adventure Education and Outdoor Learning*, 1-19. Retrieved from 10.1080/14729679.2021.2001756
Jorgenson, S., Stephens, J., & White, B. (2019). Environmental education in transition: A critical review of recent research on climate change and energy education. *The Journal of Environmental Education, 50*(3), 160-171. doi:10.1080/00958964.2019.1604478
Jurek, M., Frajer, J., Fiedor, D., Brhelova, J., Hercik, J., & Jáč, M. (2022). Knowledge of global climate change among Czech students and its influence on their beliefs in the efficacy of mitigation action. *Environmental Education Research*, 1-19. Retrieved from https://doi.org/10.1080/13504622.2022.2086687

Kahlor, L. (2007). An augmented risk information seeking model: the case of global warming. *Media Psychology, 10*(3), 414-435. doi:10.1080/15213260701532971
Kaiser, F. (1998). A general measure of ecological behaviour. *Journal of Applied Social Psychology, 28*(5), 395-422. Retrieved from https://doi.org/10.1111/j.1559-1816.1998.tb01712.x
Kaiser, F. (2007). Behaviour-based environmental attitude: Develoipment of an instrument for adolescents. *Journal of Environmental Psychology, 28*, 242-251. doi:10.1016/j.jenvp.2007.06.004
Kaiser, F., Roczen, N., & Bogner, F. X. (2008). Competence formation in environmental education: advancing ecology-specific rather than general abilities. *Umweltpsychologie, 12*(2), 56-70. Retrieved from https://doi.org/10.5167/uzh-9249
Kaniušonytė, G. (2019). *Identity and pro-environmental behaviour in adolescence and emerging adulthood: Findings from intervention piloting study.* Villnius: Environmental Psychology Research Centre. Retrieved from https://www.researchgate.net/publication/336135475_Identity_and_Pro-Environmental_Behavior_in_Adolescence_and_Emerging_Adulthood_Findings_From_Intervention_Piloting_Study
Kaplan, A., & Garner, J. (2017). A complex dynamic systems perspective on identity and its development: The dynamic systems model of role identity. *Developmental Psychology, 53*, 2036-2051. doi:10.1037/dev0000339
Karpudewan, M., & Mohd Ali Kahn, N. S. (2017). Experiential-based climate change education: fostering students' knowledge and motivation towards the environment. *INTERNATIONAL RESEARCH IN GEOGRAPHICAL AND ENVIRONMENTAL EDUCATION, 26*(3), 207-222. doi:https://doi.org/10.1080/10382046.2017.1330037
Kellstedt, P. M. (2008). Personal Efficacy, the information environment, and attitudes towards global warming and climate change in the United States. *Risk Analysis, 28*(1), 113-127. doi:10.1111/j.1539-6924.2008.01010.x
Kelly, G. (1991). *The psychology of personal construct .* London: Routledge.
Khadka, A., Lie, C. J., Stanis, S. W., & Morgan, M. (2021). Unpacking the power of place-based education in climate change communication. *Applied environmental education and communication, 20*(1), 77-91. doi:10.1080/1533015X.2020.1719238
Kirwan, P. (2021, March). *What we do*. Retrieved from Iirsh Schools Sustainability Network: https://www.issn.ie/what-we-do
Klockner, C. (2013). A comprehensive model of the psychology of environmental behavior - A meta analysis. *Global Environmental Change, 23*, 1028-1038. doi:http://dx.doi.org/10.1016/j.gloenvcha.2013.05.014
Klockner, C., & Blobaum, A. (2010). A comprehensive action determination model: Towards a broader understanding of ecological behaviour using the example of travel mode choice. *Journal of Environmental Psychology, 30*(4), 574-586. doi:https://doi.org/10.1016/j.jenvp.2010.03.001
Klockner, C., Matthies, E., & Hunecke, M. (2006). Problems of Operationalizing Habits and Integrating Habits in Normative Decision-Making Models. *Journal of Applied Social Psychology, 33*(2), 396-417. doi:https://doi.org/10.1111/j.1559-1816.2003.tb01902.x
Kollmuss, A., & Agyeman, J. (2002). Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behaviour? *Environmental Education Research, 8*(3), 239-260. doi:http://dx.doi.org/10.1080/13504620220145401
Kovács, J., Medvés , D., & Pántya, J. (2020). The relationship between environmental knowledge of preteens and their choice among plastic and non-plastic materials for a manual task. *Environmental Education Research, 26*(6), 849-863. doi:https://doi.org/10.1080/13504622.2020.1752363
Krettenauer, T. (2017). Pro-environmental behaviour and adolescent moral development. *Research on Adolescence, 27*(3), 581-593. doi:https://onlinelibrary.wiley.com/doi/10.1111/jora.12300
Kuhn, T. (1962). *The structure of scientific revolutions.* Chicago: University of Chicago Press.
Kuhn, T. (1996). *The structure of scientific revolutions* (3rd ed.). Chicago: University of Chicago Press.
Kuipers, K., & Hysom, S. (2014). Common problems and solutions in experiements. In M. Webster, & J. Sell, *Laboratory Experiments in the Social Sciences* (2nd ed., pp. 145-177). Academic Press. doi:10.1016/B978-0-12-404681-8.00007-8

Laerd Statistics. (2022). *Sphericity - Statistical Guides*. Retrieved January 27, 2023, from Laerd Statistics: https://statistics.laerd.com/statistical-guides/sphericity-statistical-guide.php

Lang, J. (2022). *IPCC Explainer: Stopping Climate Change.* Retrieved from Energy and Climate Intelligence Unit: https://ca1-eci.edcdn.com/infographics/IPCC_WGIII_Options_15_Aug_22.pdf?v=1664285366

Law, M., Stewart, D., Pollock, N., Letts, L., Bosch, J., & Westmoreland, M. (1998). *Critical Review Form for Quantitative Studies.* Hamilton: McMaster University. Retrieved from https://unisa.edu.au/siteassets/episerver-6-files/global/health/sansom/documents/icahe/cats/mcmasters_quantitative-review.pdf

Law, M., Stewart, D., Pollock, N., Letts, L., Bosch, J., & Westmorland, M. (1998). *Guidelines for critical review form - Quantitative studies.* Hamilton: McMaster University. Retrieved from https://unisa.edu.au/siteassets/episerver-6-files/global/health/sansom/documents/icahe/cats/mcmasters_quantitative-review.pdf

Lehnert, M., Fiedor, D., Frajer, J., Hercik, J., & Jurek, M. (2019). Czech students and mitigation of global warming: beliefs and willingness to take action. *Environmental Education Research*, 1-26. doi:10.1080/13504622.2019.1694140

Leigh, K. (2009). Energy Busters Norfol Schools Fight Climate Change. *Environmental Education*, 13-14.

Leiserowitz, A., Smith, N., & Marlon, J. (2011). *American teens' knowledge of climate change.* New Haven: Yale Project on climate change communication.

Lenton, T. M., Rockstrom, J., Gaffney, O., Rahmstorf, S., Richardson, K., Steffen, W., & Joachiim Schellnhuber, H. (2019). Climate tipping points - too risky to bet against. *Nature, 575*, 592-598. doi:https://media.nature.com/original/magazine-assets/d41586-019-03595-0/d41586-019-03595-0.pdf

Lester, B. T., Ma, L., Lee, O., & Lambert, J. (2006). Social activism in elementary science education: a science, technology, and society approach to teach global warming. *International Journal of Science Education, 28*(4), 315-339. doi:https://doi.org/10.1080/09500690500240100.

Li, C. J., Monroe, M., Oxarart, A., & Ritchie, T. (2021). Building teachers' self-efficacy in teaching about climate change through educative curriculum and professional development. *Applied Environmental Education and Communication, 20*(1), 34-48. doi:https://doi-org.libraryproxy.mic.ul.ie/10.1080/1533015X.2019.1617806

Lockhart, R., & Craik, F. (1990). Levels of processing: A retrospective commentary on a framework for memory research. *Canadian Journal of Experimental Psychology, 44*(1), 87-112. Retrieved from 10.1037/h0084237

Lunholm, C. (2019). Where to look and what to do? Blank and bright spots in research on environmental and climate chnage education. *Environmental Education Research, 25*(10), 1427-1437. doi:10.1080/13504622.2019.1700066

Maciejewski, M. (2020). Quasi-experimental design. *Biostatistics and Epidemiology, 4*(1), 38-47. doi:10.1080/24709360.2018.1477468

Malhi, Y., Franklin, J., Seddon, N., Solan, M., Turner, M., Field, C., & Knowlton, N. (2020). Climate change and eco-systems: threats, opportunities and solutions. *Philosophical transactions of the Royal Society B, 375*(1794). doi:https://doi.org/10.1098/rstb.2019.0104

Manoli, C., johnson, B., Hadjichambis, A., Hadjichambi, D., Georgiou, Y., & Ioannou, H. (2014). Evaluating the impact of the Earthkeepers Earth education program on children's ecological understandings, values and attitudes, and behaviour in Cyprus. *Studies in Education al Evaluation, 41*, 29-37. doi:http://dx.doi.org/10.1016/j.stueduc.2013.09.008

Martin, C., & Czellar, S. (2017). Where do biospheric values come from? A connectedness to nature perspective. *Journal of Environmental Psychology, 52*, 56-68. doi:https://doi.org/10.1016/j.jenvp.2017.04.009

Martinez Sainz, M., Mallon, B., & Oberman, R. (2019). *A Framework for Assessing the Impact of Climate Change Education in Schools.* European Educational Research Association. Retrieved from https://eera-ecer.de/ecer-programmes/conference/24/contribution/48605/

Mason, L., Ronconi, A., Scrimin, S., & Pazzaglia, F. (2021). Short-term exposure to nature and benefits for students' cognitive performance: a reviee . *Educational Psychology Review*, 1-39. doi:Short-Term Exposure to Nature and Benefits for Students' Cognitive Performance: a Review

Matthies, E., Selge, S., & Klockner, C. A. (2012). The role of parental behaviour for the development of behaviour specific environmental norms - The example of recycling and re-use behaviour. *journal of Environmental Psychology, 32*(3), 277-284. doi:10.1016/j.jenvp.2012.04.003

McDonald, J. (2008). Measuring personality constructs: The advantages and disadvantages of self-reports, informant reports and behavioural assessments. *Enquire, 1*(1), 75-94. Retrieved from https://www.nottingham.ac.uk/sociology/documents/enquire/volume-1-issue-1-dodorico-mcdonald.pdf

McIntyre, O. (2020, August). *The Irish Supreme Court Judgment in Climate Case Ireland: 'One Step Forward and Two Steps Back'.* Retrieved from IUCN: https://www.iucn.org/news/world-commission-environmental-law/202008/irish-supreme-court-judgment-climate-case-ireland-one-step-forward-and-two-steps-back

McNally, B. (2020). *Citizen's views of climate action in Ireland: Insights on media use, trusted sources and perceptions.* Wexford: Environmental Protection Agency. Retrieved from https://www.epa.ie/publications/research/climate-change/Research_Report_344.pdf

McNeal, P., Petcovic, H., & Reeves, P. (2017). What is motivating middle-school science teachers to teach climate change? *International Journal of Science Education, 39*(8), 1069-1088. doi:https://doi.org/10.1080/09500693.2017.1315466

Mead, E., Roser-Renouf, C., Rimal, R., Flora, J., Maibach, E., & Leiserowitz, A. (2012). Information seeking about global climate change among adolescents: The role of risk perceptions, efficacy beliefs and parental influences. *Atlantic Journal of Communications, 20*(1), 31-52. doi:10.1080/15456870.2012.637027

Meehan, C. R., Levy, B. L., & Collet-Gildard, L. (2018). Global climate change in U.S. high school curricula: Portrayals of the causes, consequences, and potential responses. *Science Education, 102*(3), 498-528. doi:https://doi-org.libraryproxy.mic.ul.ie/10.1002/sce.21338

Mellis, C. (2020). How to choose your study design. *Journal of Paediatrics and Child Health*, 1-5. doi:10.1111/jpc.14929

Michie, S., Johnston, M., Francis, J., Hardeman, W., & Eccles, M. (2008). From Theory to Intervention: Mapping Theoretically derived behavioural determinants to behavour change techniques. *Applied Psychology, 57*(4), 660-680. doi:10.1111/j.1464-0597.2008.00341.x

Millar, R. (2009). *Analysing practical activities to assess and improve effectiveness: The Practical Activity Analysis Inventory (PAAI).* York: Centre ofr Innovation and Research in Science Education.

Miller, N., Kumar, S., Pearce, K., & Baldock, K. (2021). The outcomes of nature-based learning for primary school aged children: a systematic review of quantitative research. *Environmental Education Research*, 1115-1140. doi:https://doi.org/10.1080/13504622.2021.1921117

Minitab Statistics. (2015, Sept). *Repeated Measures Designs: Benefits, Challenges, and an ANOVA Example.* Retrieved from Minitab: https://blog.minitab.com/en/adventures-in-statistics-2/repeated-measures-designs-benefits-challenges-and-an-anova-example

Minnock, K., Sullivan, J., & Dick, H. (2021). *Climate Action: Creating a Just and Sustainable World: Specification for Junior Cycle.* Dublin.

Mochizuki, Y., & Bryan, A. (2015). Climate change education in the context of education for sustainable development. *Journal of Education for Sustainable Development, 9*(1), 4-26. doi:10.1177/0973408215569109

Mochizuki, Y., & Bryan, A. (2015). Climate change education in the context of education for sustainable development: Rationale and principles. *Journal of Education for Sustainable Development, 9*(1), 4-26. doi:10.1177/0973408215569109

Mochizuki, Y., & Bryan, A. (2015). Climate change education in the context of education for sustainable development: Rationale and principles. *Journal of Education for Sustainable Development, 9*(1), 4-26. doi:10.1177/0973408215569109

Moellendorf, D. (2015). Climate Change Justice. *Philosophy Compass*, 173-186. doi:10.1111/phc3.12201

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLoS Med, 6*(7). doi:10.1371/journal.pmed1000097

Monroe, M., Plate, R., Oxarart, A., Bowers, A., & Chaves, W. (2017). Idenitfying effective climate change education strategies: a systematic review of the research. *Environmental Education Research*, 1-23. doi:https://doi.org/10.1080/13504622.2017.1360842

Monus, F. (2022). Environmental education policy of schools and socioeconomic background affect environmental attitudes and pro-environmental behavior of secondary school students. *Environmental Education Research, 28*, 169-196. doi:10.1080/13504622.2021.2023106

Moore, E., Wilkie, W., & Alder, J. (2001). Lighting the torch: How do intergenerational influences develop? *Advances in Consumer Research, 28*, 287-293. Retrieved from https://www.acrwebsite.org/volumes/8492/volumes/v28/NA-28/full

Movement Generation. (2022, 1 14). *Propogate, Pollinate, Practice: Curriculum tools for a just transition.* Retrieved from Movement Generation: https://movementgeneration.org/wp-content/uploads/2018/12/Propagate-Pollinate-Practice-Final.pdf

Muhlisin, M., Rosiana, I., Rahayuningsih, Y., & Suharyana, Y. (2019). The efforts to improve environmental behavior and critical thinking of students through guided inquiry-based learning on environmental education-based science. *Jurnal Penelitian dan Pembelajaran IPA, 5*(2), 202-218. doi:10.30870/jppi.v5i2.4681

Murphy, C., Smith, G., & Broderick, N. (2019). A starting point: Provide children with opportunities to engage with scientific inquiry and nature of science . *Research in Science Education*. doi:10.1007/s11165-019-9825-0

NCCA. (2009). *Aistear: the Early Childhood Curriculum Framework.* Dublin: National Council for Curriculum and Assessment. Retrieved 10 18, 2022, from https://curriculumonline.ie/getmedia/484bcc30-28cf-4b24-90c8-502a868bb53a/Aistear-Principles-and-Themes_EN.pdf

NCCA. (2020). *Draft Primary Curriculum Framework.* Dublin: National Council for Curriculum and Assessment. Retrieved 10 18, 2022, from https://ncca.ie/media/4870/en-primary-curriculum-framework-dec-2020.pdf

NCCA. (2022). *Background paper and brief for the development of Leaving Certificate Climate Action and Sustainable Development.* Dublin: National Council for Curriculum and Assessment. Retrieved 10 14, 2022, from https://ncca.ie/media/5640/background-paper-for-lc-casd_0622

NCCA. (2022). *Background paper and brief for the development of Leaving Certificate Climate Action and Sustainable Development.* Dublin: NCCA. Retrieved February 6, 2023, from https://ncca.ie/en/resources/background-paper-and-brief-for-the-development-of-leaving-certificate-climate-action-and-sustainable-development/

NCCA. (2022). *Consultation Report on the background paper and brief for the development of leaving certificate climate action and sustainable development.* Dublin: National Council for Curriculum and Assessment. Retrieved February 10, 2023, from https://ncca.ie/media/5921/bgp-casd_-consultation-report_1222.pdf

NCCA. (2022a). *Senior cycle review: Advisory report.* Dublin: National Council for Curriculum and Assessment. Retrieved 10 14, 2022, from https://ncca.ie/media/5399/scr-advisory-report_en.pdf

NCCA. (2022b). *Background paper and brief for the development of Leaving Certificate Climate Action and Sustainable Development.* Dublin: National Council for Curriculum and Assessment. Retrieved 10 14, 2022, from https://ncca.ie/media/5640/background-paper-for-lc-casd_0622

Nevin, E. (2008). Education for Sustainable Development. *Policy and Practice*, 49-63. Retrieved from https://www.developmenteducationreview.com/sites/default/files/Issue6.pdf

Nourmoradi, H., Asadi, M., Mehdi-Naghizadeh, S., Mazloomi, S., & Ghazanfari, Z. (2021). The influence of an education program on students' environmental responsibility in developing countries: evidence from Iran. *Journal of Human Behavior in the Social Environment*, 1-12. Retrieved from 10.1080/10911359.2021.1987368

Nourmoradi, H., Asadi, M., Mehdi-Naghizadeh, S., Mazloomi, S., Ghazanfari, Z., & Quam. (2021). The influence of an education program on students' environmental responsibility in developing countries: evidence from Iran. *Journal of Human Behavior in the Social Environment*, 1-12. Retrieved from 10.1080/10911359.2021.1987368

Oerke, B., & Bogner, F. (2011). Social desirability, environmental attitudes, and general ecolgoical behaviour in children. *International Journal of Science Education, 35*(5), 713-730. doi:https://doi.org/10.1080/09500693.2011.566897

Ojala, M. (2005). Adolescents' Worries about Environmental Risks: Subjective Well-Being, Values, and Existential Dimensions. *Journal of Youth Studies, 8*(3), 331-347.

Ojala, M. (2012). Hope and climate change: The importance of hope for environmental engagement among young people. *Environmental Education Research, 18*, 625-642. doi:https://dx.doi.org/10.1080/13504622.2011.637157

Ojala, M. (2012). How do children cope with global climate change? Coping strategies, engagement, and well-being. *Journal of Environmental Psychology*, 225-233. doi:10.1016/j.jenvp.2012.02.004

Ormston, R., Spencer, L., Barnard, M., & Snape, D. (2014). The foundations of qualitative research. In J. Ritchie, J. Lewis, C. Nicholls, & R. Ormston, *Qualitative research practice: A guide for social science students and researchers* (pp. 1-25). Los Angeles: Sage.

Orr, D. W. (1997). Architecture as Pedagogy. *Conservation Biology, 11*(3), 597-600. Retrieved from https://www.jstor.org/stable/2387419

Otto, S., Evans, G., Moon, M., & Kaiser, F. (2019). The development of children's environmental attitude and behaviour. *Global Environmental Change, 58*, 1-6. doi:https://doi.org/10.1016/j.gloenvcha.2019.101947

Ouellette, J., & Wood, W. (1998). Habit and intention in everyday life: The multiple processes by which past behaviour predict future behaviour. *Psychological Bulletin, 124*(1), 54-74. Retrieved from https://dornsife.usc.edu/assets/sites/208/docs/Ouellette.Wood.1998.pdf

Oyserman, D. (2015). Values, Psychology of. In J. D. Wright, *International Encyclopedia of the Social and Behavioural Sciences* (Vol. 25, pp. 36-40). Oxford: Elsevier. doi:10.1016/B978-0-08-097086-8.24030-0

Page, E. (2013). Climate Change Justice. In R. Falkner, *The Handbook of Global Climate and Environment Policy* (pp. 231-247). Chichester: Wiley-Blackwell.

Pallant, J. (2020). *SPSS survival manual: A step by step guide to data analysis using SPSS* (7th ed.). London: Routledge. doi:10.4324/9781003117452

Parahoo, K. (2014). *Nursing research: principles, process and issues* (3rd ed.). Basingstoke: Palgrave-Macmillan.

Parant, A., Pascaul, A., Jugel, M., Kerroume, M. M., & Gueguen, N. (2017). Raising students awareness to Climate Change: An illustration with binding communication. *Environment and Behaviour, 49*(3), 339-353. doi:10.1177/0013916516629191

Pasanen, T. P., Tyrväinen, L., & Korpela, K. (2014). The relationship between perceived health and physical activity indoors, outdoors in built environmnets and outdoors in nature. *Applied Psychology: Health and Well-being, 6*, 324-346. doi:https://doi-org.libraryproxy.mic.ul.ie/10.1111/aphw.12031

Payne, P. (2000). Idenitty and environmental education. *Environmental Education Research, 7*(1), 67-88. doi:10.1080/13504620124658

Pirages, D., & Ehrlich, P. (1974). *Ark II: Social response to environmental imperatives.* San Francisco: W. H Freeman and Co. .

Popper, K. (1959). *The logic of scientific discovery.* New York: Basic Books.

Prager, K. (2012). *Understanding Behaviour Change.* Edinborough : James Hutton institute.

Price, P., Jhangiani, R., Chiang, I., Leighton, D., & Cuttler, C. (2017). *Research Methods in Psychology* (3rd ed.). Seattle: Washington State University.

Pruneau, D., Doyon, A., Langis, J., Vasseur, L., Martin, G., Ouellet, E., & Boudreau, G. (2006). The Process of Change Experimented by Teachers and Students when Voluntarily Trying Environmental Behaviors. *Applied Environmental Education and Communication, 5*(1), 33-40. doi:https://doi.org/10.1080/15330150500452349

Pruneau, D., Gravel, H., Bourque, W., & Langis, J. (2003). Experimentation with a Socio-Constructivist Process for Climate Change Educatio. *Environmental Education Research, 9*(4), 429-446. doi:10.1080/1350462032000126096

Psychological Society of Ireland. (2019). *Code of Professional Ethics.* Dublin: PSI. Retrieved 4 21, 2021, from https://www.psychologicalsociety.ie/footer/Code-of-Ethics

Punter, P., Ochando-Pardo, M., & Garcia, J. (2011). Spanish secondary school students' notions on the causes and consequences of climate change. *International Journal of Science Education, 33*(3). doi:https://doi.org/10.1080/09500693.2010.492253

Reed, N., & Page, N. (2016). Changing behavior to being more environmentally friendly. In D. Winter, & N. Reed, *The Wiley handbook of personal construct psychology* (pp. 487-498). WIley-Blackwell. doi:https://doi.org/10.1002/9781118508275.ch39

Reed, N., & Page, N. (2016). Changing behavior to being more environmentally friendly. In D. Winter, & N. Reed, *The Wiley handbook of personal construct psychology* (pp. 487-498). WIley-Blackwell.

Riggs Stapleton, S. (2015). Environmental idenitty developmnet through social interactions, action and recognition. *The Journal of Environmental Education, 46*(2), 94-113. doi:10.1080/00958964.2014.1000813

Ritchie, S., Della Salla, S., & McIntosh, R. (2013). Retrieval practice, with or without mind mapping boosts fact learning in primary school children. *Plos One, 8*(11), 1-9. doi:10.1371/journal.pone.0078976

Robelia, B. A., Greenhow, C., & Burton, L. (2011). Environmental learning in online social networks: adopting environmentally responsible behaviours. *Environmnetal Education Research, 17*(4), 553-575. doi:10.1080/13504622.2011.565118

Robinson, A., Downey, L., Ford, T., Lomas, J., & Stough, C. (2019). Green teens: investigating the role of emotional intelligence in adolesccent environmentalism. *Personality and Individual Differences, 138*, 225-230. doi:10.1016/j.paid.2018.10.009

Roczen, N., Kaiser, F., Bogner, F., & Wilson, M. (2013). A competence model for environmental education. *Environment and Behavior, 46*(8), 972-992. doi:10.1177/0013916513492416

Ronaghi, M. H. (2022). The effect of virtual reality technology and education on sustainable behavior: a comparative quasi-experimental study. *Interactive technology and smart education*, 1-18. doi:http://dx.doi.org/10.1108/ITSE-02-2022-0025

Ross, H., Rudd, J., Skains, R. L., & Horry, R. (2021). How Big Is My Carbon Footprint? Understanding Young People's Engagement with Climate Change Education. *Sustainability, 13*, 1-19. doi:https://doi.org/10.3390/su13041961

Rossi, P., Freeman, H., & Lipsey, M. (1999). *Evaluation: A systematic approach* (6th ed.). Thousand Oaks CA: Sage.

Rousell, D., & Cutter-Mackenzie-Knowles, A. (2020). A systematic review of climate change education: giving children. *Children's geographies, 18*(2), 191-208. doi:10.1080/14733285.2019.1614532

Rudd, J., Horry, R., & Skains, R. L. (2020). You and CO2: a Public Engagement Study to Engage Secondary School Students with the Issue of Climate Change. *Journal of Science Education and Technology, 29*, 230-241. doi:https://doi.org/10.1007/s10956-019-09808-5

Sadler-Smith, E. (2015). Communicating climate change risk and enabling pro-environmental behavioral change through human resource development. *Advances in developing human resources, 17*(4), 442-459. doi:10.1177/1523422315601087

Saja Sanneh, E. (2018). *Systems thinking for sustainable development: Climate change and the environment.* AG: Springer. Retrieved from https://doi.org/10.1007/978-3-319-70585-9_10

Salazar, C., Jaime, M., Leiva, M., & Gonzalez, N. (2022). From theory to action: Explaining the process of knowledge attitudes and practices regarding the use and disposal of plastic among school children. *Journal of Environmental Psychology, 80*, 1-12. Retrieved from 10.1016/j.jenvp.2022.101777

Schultz, P., Gouveia, V., Cameron, L., Tankha, G., Schmuck, P., & Franek, M. (2005). Values and their relationship to environmental concern and conservation behaviour. *Journal of Cross-Cultural Psychology, 36*(4), 457-475. doi:10.1177/0022022198294003

Schwartz, S. H. (2012). Values and religion in adolescent developmnet: cross-national and comparative evidence. In G. Trommsdorff, & X. Chen, *Values, religion and culture in adoelscent development* (pp. 97-122). New York: Cambridge University Press. doi:10.1017/CBO9781139013659.007

Schwartz, S., & Howard, J. (1981). A normative decision-making model of altruism. In J. Rushton, & R. Sorrentino, *Altruism and Helping Behaviour* (pp. 89-211). Hillsdale: Lawerence Erlbaum.

Sellman, D., & Bogner, F. (2013). Effects of a 1-Day Environmental Education Intervention on Environmental Attitudes and Connectedness with Nature. *European Journal of Psychology of Education, 28*(3), 1077-1086. doi:http://dx.doi.org.libraryproxy.mic.ul.ie/10.1007/s10212-012-0155-0

Sellmann, D., & Bogner, F. (2013). Effects of a 1-day environmental education intervention on environmental attitudes and connectedness with nature. *European Journal of Psychology of Education, 28*(3), 1077-1086. doi:10.1007/s10212-012-0155-0

Senge, P. (1990). *The fifth discipline: The art and science of the learning organisation.* New York: Currency Doubleday.

Sezen-Barrie, A., Miller-Rushing, A., & Hufnagel, E. (2020). 'It's a gassy world': starting with students' wondering questions to inform climate change education. *Environmental Education Research, 26*(4), 555-576. doi:10.1080/13504622.2019.1610158

Shapiro, M. (1985). A reassessment of clinical psychology as an applied science. *British Journal of Clinical Psychology, 24*, 1-11. doi:10.1111/j.2044-8260.1985.tb01308.x

Shepardson, D., Niyogi, D., Choi, S., & Charusombat, U. (2011). Students' conceptions about the greenhouse effect, global warming and climate change. *Climatic Change, 104*, 481-507. doi:10.1007/s10584-009-9786-9

Sia, A., Hungerford, H., & Tomera, A. (1986). Selected predictors of responsible environmental behaviour: An analysis `. *The Journal of Environmental Education*, 31-40. doi:10.1080/00958964.1986.9941408

Sinatra, G., Kardash, G., Taasoobshirazi, G., & Lombardi, D. (2012). Promoting Attitude Change and Expressed Willingness to Take Action Toward Climate Change in College Students. *Instructional Science, 40*(1), 1-17.

Smith, J., & Noble, H. (2014). Bias in research. *Evidence based nursing, 17*(4), 1-2. Retrieved from https://ebn.bmj.com/content/ebnurs/17/4/100.full.pdf

Smith-Sebasto, N., & Fortner, R. (1994). The environmental action internal control index: voluntary mitigation and barriers to behaviour change. *The Journal of Environmental Education, 25*(4), 23-29. doi:10.1080/00958964. 1994.9941961.

Somerwill, L., & Wehn, U. (2022). How to measure the impact of citizen science on environmental attitudes, behaviour and knowledge? A review of state-of-the-art approaches. *Environmental Sciences Europe, 34*(18), 1-13. doi:10.1186/s12302-022-00596-1

Spitzer, S., & Weber, D. (2019). Reporting biases in self-assessed physical and cognitive health status of older Europeans. *PLoS One, 8*(14), 1-10. doi:10.1371/journal.pone.0223526

SSGA. (2020). *Carbon Footprinting: An investors toolkit.* New York: SSGA. Retrieved from https://www.ssga.com/library-content/pdfs/insights/carbon-footprinting-an-anvestor-toolkit.pdf

Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology, 29*(3), 31-42. doi:https://doi.org/10.1016/j.jenvp.2008.10.004

Stern, P. (2000). Toward a coherent theory of environmentally significant behaviour. *Journal of Social Issues, 56*(3), 407-424. Retrieved from https://web.stanford.edu/~kcarmel/CC_BehavChange_Course/readings/Stern_metareview_2000.pdf

Stevenson, K. T., Nils Peterson, M., & Bondell, H. D. (2018). Developing a model of climate change behaviour among adolescents. *Climate Change*, 1-15. Retrieved from https://doi.org/10.1007/s10584-018-2313-0

Stevenson, K. T., Peterson, N., & Bondell, H. D. (2018). Developing a model of climate change behaviour among adolescents. *Climate Change*, 1-15. Retrieved from https://doi.org/10.1007/s10584-018-2313-0

Stevenson, K., & Nils Peterson, M. (2015). Motivating action through fostering climate change hope and concern and avoiding despair among adolescents. *sustainability, 8*(1). Retrieved from https://doi.org/10.3390/su8010006

Stevenson, K., & Peterson, N. (2015). Motivating action through fostering climate change hope and concern and avoiding despair among adolescents. *sustainability, 8*(1). Retrieved from https://doi.org/10.3390/su8010006

Stevenson, K., Lashley, M., Chitwood, M., & et al. (2015). How emotion trumps logic in climate change risk perception: exploring the affective heuristic among wildlife science students. *Hum Dimens Wildl, 20*, 501-513. Retrieved from https://doi.org/10.1080/10871209.2015.1077538

Stevenson, K., Peterson, M., & Bondell, H. (2014). Overcoming skepticism with education: interacting influences of worldview and climate change knowledge on perceived climate change risk among adolescents. *Climate Change, 126*, 293-304. doi:https://doi.org/10.1007/s10584-014-1228-7

Stevenson, K., Peterson, M., Bondell, H., & et al. (2013). Overcoming skepticism with education: interacting influences of worldview and climate change knowledge on perceived climate change risk among adolescents. *Climate Change, 126*, 293-304. doi:https://doi.org/10.1007/s10584-014-1228-7

Stevenson, K., Peterson, M., Bondell, H., & et al. (2014). Overcoming skepticism with education: interacting influences of worldview and climate change knowledge on perceived climate change risk among adolescents. *Climate Change, 126*, 293-304. doi:https://doi.org/10.1007/s10584-014-1228-7

Stripple, J., & Stephan, H. (2013). Global Governance. In R. Falkner, *The handbook of global climate and environmental policy* (pp. 146-162). Chichester: Wiley-Blackwell. Retrieved from 10.1002/9781118326213.ch9

Sumrall, W., & Sumrall, K. (2021). Changing attitude into behavior: How to reduce carbon dioxide emissions. *Science Activities, 58*(1), 23-33. Retrieved from 10.1080/00368121.2021.1885334

Sund, L. (2016). Facing global sustainability issues: teachers' experiences of their own practices in environmental and sustainability education. *Environmental Education Research, 22*(6), 788-805. doi:10.1080/13504622.2015.1110744

Tallulah, T. (2018, January 10). *Individual vs Collective: Are you responsible for fixing climate change?* Retrieved from resilience: https://www.resilience.org/stories/2018-01-10/individual-vs-collective-are-you-responsible-for-fixing-climate-change/

Taylor , M., & Watts, J. (2019, October). *Revealed: the 20 firms behind a third of all carbon emissions.* Retrieved from The Guardian: https://www.theguardian.com/environment/2019/oct/09/revealed-20-firms-third-carbon-emissions

Thøgersen, J. (1996). Recycling and Morality: A critical review of the literature. *Environment and Behaviour, 28*, 546-558. doi:https://doi.org/10.1177/0013916596284006

Thomas, L. (2013, 2022 12). *Control groups and treatment groups: uses and examples.* Retrieved Feb 2, 2023, from Scribbr: https://www.scribbr.com/methodology/control-group/

Thompson, S. (2017, Feb 25). Students pull on the green jersey: The Green Schools scheme has boosted environmental awareness around Ireland. *The Irish Times*, p. 6. Retrieved 07 2022, 13, from http://libraryproxy.mic.ul.ie/login?url=https://www.proquest.com/newspapers/students-pull-on-green-jersey/docview/1871703076/se-2?accountid=55804

Timms, M. (2016, March). *The relationship between corporations and climate change.* Retrieved from World Finance: https://www.worldfinance.com/special-reports/the-relationship-between-corporations-and-climate-change

Tomlinson, Y. N. (2023, January 3). The importance of engaging with ontology and epistemology as an ECR. *Careers and employment, education, teaching and learning*. Retrieved from https://www.bps.org.uk/psychologist/importance-engaging-ontology-and-epistemology-ecr

Tonglet, M., Phillips, P., & Read, A. (2004). Using the theory of planned behaviour to investigate the determinants of recycling behaviour: a case study from Brixworth UK. *Resources, Conservation and Recycling, 41*(3), 191-214. doi:https://doi.org/10.1016/j.resconrec.2003.11.001

Transition Network. (2021, November). *Principles*. Retrieved from Transition Network: https://transitionnetwork.org/about-the-movement/what-is-transition/principles-2/

Truelove, H., & Parks, C. (2012). Perceptions of behaviours that cause and mitigate global warming and intentions to perform these behaviours. *Journal of Environmental Psychology, 32*, 246-259. doi:http://dx.doi.org/10.1016/j.jenvp.2012.04.002.

Tucker, R., & Izadpanahi, P. (2017). Live gree, think green: Sustainable school architecture and children's environmental attitudes and behaviours. *Journal of Environmental Psychology, 51*, 209-216. doi:10.1016/j.jenvp.2017.04.003

Tukker, A., & Jansen, B. (2008). Environmental impacts of products: A detailed review of studies. *Journal of Industrial Ecology, 10*(3), 159-182. doi:https://doi.org/10.1162/jiec.2006.10.3.159

UCLA. (2016). *What does Cronbach's alpha mean?* Retrieved Feb 1, 2023, from UCLA Statistical Methods and Data Analysis: https://stats.oarc.ucla.edu/spss/faq/what-does-cronbachs-alpha-mean/

UENSCO. (2021). *Getting every school climate-ready: how countries are integrating climate change issues in education.* Paris: UNESCO. Retrieved 10 14, 2022, from https://unesdoc.unesco.org/ark:/48223/pf0000379591

Uitto, A., Boeve-de pauw, J., & Saloranta, S. (2015). Participatory school experiences as facilitators for adolescents' ecological behavior. *Journal of Environmental Psychology, 43*, 55-65. doi:10.1016/j.jenvp.2015.05.007

Unal, A., Steg, L., & Granskaya, J. (2019). “To support or not to support, that is the question”. Testing the VBN theory in predicting support for car use reduction policies in Russia. *Transp. Res. Part A Policy Pract, 119*, 73-81. doi:10.1016/J.TRA.2018.10.042

UNDP and University of Oxford. (2021). *People's Climate Vote.* Oxford: UNDP. Retrieved Feb 21, 2021, from https://www.undp.org/content/undp/en/home/librarypage/climate-and-disaster-resilience-/The-Peoples-Climate-Vote-Results.html

UNESCO. (2010). *Climate change education for sustainable development.* Paris: UNESCO. Retrieved from https://unesdoc.unesco.org/ark:/48223/pf0000190101.locale=en

UNESCO. (2019). *Framework for the implementation of Education for Sustainable Development (ESD) beyond 2019.* Paris: UNESCO. Retrieved from https://unesdoc.unesco.org/ark:/48223/pf0000370215?posInSet=3&queryId=193a9aaa-7167-4d98-8436-9f6361

UNESCO. (2020). *Education for Sustainable Development: A roadmap.* Paris: UNESCO. Retrieved from https://www.gcedclearinghouse.org/resources/education-sustainable-development-roadmap

UNESCO. (2020). *Education for Sustainable Development: A roadmap.* Paris: UNESCO. Retrieved 10 14, 2022, from https://unesdoc.unesco.org/ark:/48223/pf0000374802.locale=en

UNESCO. (2021). *Getting every school climate-ready: how countries are integrating climate change issues in education.* Paris: UNESCO. Retrieved 10 14, 2022, from https://unesdoc.unesco.org/ark:/48223/pf0000379591

UNESCO/UNEP. (2011). *Climate change starter's guidebook: An issues guide for education planners and practitioners.* Paris: UNESCP/UNEP. Retrieved from https://www.gcedclearinghouse.org/resources/climate-change-starters-guidebook-issues-guide-education-planners-and-practitioners?language=en

United Nations. (1992). *United Nations Framework Convention on Climate Change.* Madrid: UN. Retrieved 08 9, 2021, from https://unfccc.int/files/essential_background/background_publications_htmlpdf/application/pdf/conveng.pdf

Valdez, R., Peterson, M. N., & Stevenson, K. (2018). How communication with teachers, family and friends contributes to predicting climate change behaviour among adolescents. *Environmental Conservation, 45*(2), 183-191. doi:10.1017/S0376892917000443

Van Assche, K., Verschraegen, G., Valentinov, V., & Gruezmacher, M. (2019). The social, the ecological, and the adaptive. Von Bertalanffy's general systems theory and the adaptive governance of social-ecological systems. *Systems research and Behavioral science, 36*(3), 308-321. doi:https://doi-org.libraryproxy.mic.ul.ie/10.1002/sres.2587

van de Wetering, J., Leijten, P., Spitzer, J., & Thomaes, S. (2022). Does environmental education benefit environmental outcomes in children and adolescents? A meta-analysis. *Journal of Environmental Psychology, 81*, 1-12. doi:https://doi.org/10.1016/j.jenvp.2022.101782

van der Goot, W., Cristancho, S., de Carvalho Filho, M., Jaarsma, A., & Helmich, E. (2020). Trainee-environment interactions that stimulate motivation: A rich pictures study. *Medical Education, 54*, 242-253. doi:10.1111/medu.14019

van der Werff, E., Steg, L., & Keizer, K. (2013). The value of environmental self-identity: the relationship between biospheric values, environmental self-identity and environmental preferences, intentions and behaviour. *Journal of Environmental Psychology*, 55-63. doi:10.1016/j.jenvp.2012.12.006

Vazquez-Vilchez, M., Garrido-Rosales, D., Perez-Fernandez, B., & Fernandez-Oliveras, A. (2021). Using a Cooperative Educational Game to Promote Pro-Environmental Engagement in Future Teachers. *Education Sciences, 11*(691), 1-18. doi:10.3390/educsci11110691

Vechione, M., Schwartz, S., Davidov, E., Cieciuch, J., Alessandri, G., & Marsicano, G. (2019). Stability and change of basic personal values in early adolescence: a 2 year longitudinal study. *Journal of Personality, 88*, 447-463. doi:https://doi.org/10.1111/jopy.12502

Verplanken, B., & Aarts, H. (1999). Habit, Attitude, and Planned Behaviour: Is Habit an Empty Construct or an Interesting Case of Goal-directed Automaticity? *European Review of Social Psychology, 10*(1), 101-134. doi:https://doi.org/10.1080/14792779943000035

Vining, J., & Ebreo, A. (1992). Predicting recycling behaviour from global and specific environmental attitudes and changes in recycling opportunities. *Journal of Applied Social Psychology, 22*(20), 1580-1607. doi:10.1111/j.1559-1816.1992.tb01758.x

Wade, R. (2014). Learning for sustainability: the challenges for education policy and practice. In H. Atkinson, & R. Wade, *The challenges of sustainability: linking politics, educaiton and learning* (pp. 63-86). Bristol: Bristol Policy Press.

Wainwright, T., & Mitchell, A. (2020). *Psychology and the climate and environmental crisis.* London: British Psychological Society. Retrieved from https://cms.bps.org.uk/sites/default/files/2022-08/Clinical%20Psychology%20Forum%20332%20-%20Psychology%20and%20the%20climate%20and%20environmental%20crisis.pdf

Watkins, D., & Halton, C. (2010). *The big picture on biodiversity and climate change.* Ontario: Biodiversity and Education and Awareness Network.

Webster, M., & Sell, J. (2014). *Laboratory Experiments in the Social Sciences* (2nd ed.). New York: Elsevier. doi:https://doi.org/10.1016/C2011-0-07562-2

Wen, W., & Lu, S. (2013). Marine environmental protection knowledge, attitudes, behaviors, and curricular involvement of Taiwanese primary school students in senior grades. *Environmental Education Research, 19*, 600-619. doi:10.1080/13504622.2012.717219

Whitmarsh, L. (2008). What's in a name? Commonalities and differences in public understanding of “climate change” and “global warming”. *Public Understanding of Science, 18*(4), 401-420. doi:https://doi-org.libraryproxy.mic.ul.ie/10.1177/0963662506073088

Whyte, K. (2019). Too late for indigenous climate justice: Ecological and relational tipping points. *WIREs Climate Change*, 1-7. Retrieved from 10.1002/wcc.603

Wigfield, A., Byrnes, J., & Eccles, J. (2006). Development during early and middle adolescence. In P. Alexander, & P. Winne, *Handbook of Educational Psychology* (pp. 87-113). Mahwah: Lawrence Erlbaum Associates Publishers.

Working Group III of the IPCC. (2022). *Climate Change 2022 Mitigation of Climate Change.* Geneva: IPCC. Retrieved from https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_SPM.pdf

Wu, J., & Otsuka, Y. (2021). Pro-climate behaviour and the influence of learning sources on it in Chinese adolescents. *International research in geographical and environmnetal education, 30*(1), 24-38. doi:10.1080/10382046.2020.1761063

Yang, B., Wu, N., Tong, Z., & Sun, Y. (2022). Nature-based environmental education improves environmental awarness and environmental attitudes. *Environmental Research and Public Health, 19*, 1-19. doi:https://doi.org/10.3390/ijerph19116483

Yli-Panula, E., Jeronen, E., & Lemmetty, P. (2020). Teaching and learning methods in geography promoting sustainability. *Education Sciences, 10*(5), 1-18. doi:http://dx.doi.org/10.3390/educsci10010005

Zeidner, M., & Endler, N. (1996). *Handbook of coping: Theory, research, applications.* New York: John Wiley & Sons.

Zografakis, N., Menegaki, A., & Tsagarakis, K. (2008). Effective education for energy efficiency. *Enery Policy, 36*(8), 3226-3232. doi:10.1016/j.enpol.2008.04.021

Zsóka, A., Szerényi, Z., Szechy, A., & Kocsis, T. (2013). Greening due to environmental education? Environmental knowledge, attitudes, consumer behavior and everyday pro-environmental activities of Hungarian high school and university students. *Journal of Cleaner Production, 48*, 126-138. Retrieved from https://doi.org/10.1016/j.jclepro.2012.11.030

5.2 Appendix 2: McMaster Scores for studies

Study Name: 1. Developing a model of climate change behaviour among adolescents Reference: (Stevenson, Nils Peterson, & Bondell, Developing a model of climate change behaviour among adolescents, 2018)			
#	**Section**	**Yes/No/ NA / Partly**	**Points**
1	Study Purpose	Y	1
2	Literature	N	0
3a	Sample A (Description)	Y	1
3b	Sample B (Justification)	Y	1
4a	Outcomes A (Reliability)	N (teacher reliant)	0
4b	Outcomes B (Validity)	Y	1
5a	Intervention A (Description)	Y	1
5b	Intervention B (Contamination)	N	0
6a	Results A (stat sig explained)	Y	1
6b	Results B (analysis method)	Y	1
6c	Results C (Importance for practice)	Y	1
6d	Results D (dropouts)	Y	1
7	Conclusion and implications	Y	1
	Total Points:		10/13

Study Name: 2. Middle and high school students' conceptions of climate change mitigation and adaptation strategies. Reference: (Bofferding & Kloser, Middle and high school students conceptions of climate change mitigation and adaption strategies, 2015)			
#	**Section**	**Yes/No/ NA**	**Points**
1	Study Purpose	Y	1
2	Literature	Y	1
3a	Sample A (Description)	Y	1
3b	Sample B (Justification)	Y	1
4a	Outcomes A (Reliability)	N	0
4b	Outcomes B (Validity)	Y	1
5a	Intervention A (Description)	Y	1
5b	Intervention B (Contamination)	0	0
6a	Results A (stat sig explained)	Y	1

6b	Results B (analysis method)	Y	1
6c	Results C (Importance for practice)	Y	1
6d	Results D (dropouts)	N	0
7	Conclusion and implications	n	0
	Total Points:		9/13
Study Name: 3: Effects of a 1-day environmental education intervention on environmental attitudes and connectedness with nature. Reference: (Sellmann & Bogner, 2013)			
#	**Section**	**Yes/No/ NA**	**Points**
1	Study Purpose	Y	1
2	Literature	N	0
3a	Sample A (Description)	Y	1
3b	Sample B (Justification)	N	0
4a	Outcomes A (Reliability)	Y	1
4b	Outcomes B (Validity)	Y	1
5a	Intervention A (Description)	Y	1
5b	Intervention B (Contamination)	Y	0
6a	Results A (stat sig explained)	Y	1
6b	Results B (analysis method)	Y	1
6c	Results C (Importance for practice)	Y	1
6d	Results D (dropouts)	N	0
7	Conclusion and implications	y	1
	Total Points:		9/13

Study Name: 4. Changing attitude into behaviour: How to reduce carbon dioxide emissions Reference: (Sumrall & Sumrall, 2021)			
#	**Section**	**Yes/No/ NA**	**Points**
1	Study Purpose	Y	1
2	Literature	y	1
3a	Sample A (Description)	N	0
3b	Sample B (Justification)	N	0
4a	Outcomes A (Reliability)	N	0
4b	Outcomes B (Validity)	N	0
5a	Intervention A (Description)	Y	1
5b	Intervention B (Contamination)	Y	1

6a	Results A (stat sig explained)	N	0
6b	Results B (analysis method)	N	0
6c	Results C (Importance for practice)	Y	1
6d	Results D (dropouts)	N	0
7	Conclusion and implications	Y	1
	Total Points:		6/13
Study Name: 5.Unpacking the power of place-based education in climate change communication Reference: (Khadka, Lie, Stanis, & Morgan, 2021)			
#	**Section**	**Yes/No/ NA**	**Points**
1	Study Purpose	Y	1
2	Literature	y	1
3a	Sample A (Description)	N	0
3b	Sample B (Justification)	Y	1
4a	Outcomes A (Reliability)	N	0
4b	Outcomes B (Validity)	Y	1
5a	Intervention A (Description)	Y	1
5b	Intervention B (Contamination)	N	0
6a	Results A (stat sig explained)	Y	1
6b	Results B (analysis method)	Y	1
6c	Results C (Importance for practice)	Y	1
6d	Results D (dropouts)	N	0
7	Conclusion and implications	n	0
	Total Points:		8/13
Study Name: 6. The Process of Change Experimented by Teachers and Students when Voluntarily Trying Environmental Behaviours Reference: (Pruneau, et al., 2006)			
#	**Section**	**Yes/No/ NA**	**Points**
1	Study Purpose	Y	1
2	Literature	Y	1
3a	Sample A (Description)	Y	1
3b	Sample B (Justification)	Y	1
4a	Outcomes A (Reliability)	N	0
4b	Outcomes B (Validity)	N	0
5a	Intervention A (Description)	Y	1
5b	Intervention B (Contamination)	N	0

6a	Results A (stat sig explained)	N	0
6b	Results B (analysis method)	N	0
6c	Results C (Importance for practice)	N	0
6d	Results D (dropouts)	N	0
7	Conclusion and implications	y	1
	Total Points:		6/13

Study Name: 7. Pupils Knowledge and Behaviour Intention among Primary Pupils Ref: (Ismail, Ayub, & Subramanian, 2021)			
#	**Section**	**Yes/No/ NA / Partly**	**Points**
1	Study Purpose	Y	1
2	Literature	N	0
3a	Sample A (Description)	N	0
3b	Sample B (Justification)	Y	1
4a	Outcomes A (Reliability)	N	0
4b	Outcomes B (Validity)	Y	1
5a	Intervention A (Description)	N	0
5b	Intervention B (Contamination)	N	0
6a	Results A (stat sig explained)	Y	1
6b	Results B (analysis method)	Y	1
6c	Results C (Importance for practice)	Y	1
6d	Results D (dropouts)	N	0
7	Conclusion and implications	Y	1
	Total Points:		7/13

Study Name: 8. **Pro-climate behaviour and the influence of learning sources on it in Chinese adolescents** Ref. (Wu & Otsuka, 2021)			
#	**Section**	**Yes/No/ NA**	**Points**
1	Study Purpose	Y	1
2	Literature	Y	1
3a	Sample A (Description)	Y	1
3b	Sample B (Justification)	Y	1

4a	Outcomes A (Reliability)	Y	1
4b	Outcomes B (Validity)	Y	1
5a	Intervention A (Description)	N	0
5b	Intervention B (Contamination)	N	0
6a	Results A (stat sig explained)	Y	1
6b	Results B (analysis method)	Y	1
6c	Results C (Importance for practice)	Y	1
6d	Results D (dropouts)	n	0
7	Conclusion and implications	Y	1
Total Points:			11/13

Study Name: 9. The building of knowledge, language, and decision-making about climate change science: a cross-national program for secondary students

Ref: (Arya & Maul, 2016)

#	**Section**	**Yes/No/ NA**	**Points**
1	Study Purpose	Y	1
2	Literature	Y	1
3a	Sample A (Description)	Y	1
3b	Sample B (Justification)	Y	1
4a	Outcomes A (Reliability)	n	0
4b	Outcomes B (Validity)	Y	1
5a	Intervention A (Description)	Y	1
5b	Intervention B (Contamination)	Y	1
6a	Results A (stat sig explained)	Y	1
6b	Results B (analysis method)	Y	1
6c	Results C (Importance for practice)	Y	1
6d	Results D (dropouts)	y	1
7	Conclusion and implications	n	0
Total Points:			11/13

Study Name:10. Bridging the Action Gap by Democratizing Climate Change Education—The Case of k.i.d.Z.21 in the Context of Fridays for Future

Ref: (Deisenrieder , Kubisch, Keller, & Stötter, Bridging the action gap by democratizing climate change education-The case of k.i.d.Z.21 in the context of Fridays for Future, 2020)

#	Section	Yes/No/ NA / Partly	Points
1	Study Purpose	Y	1
2	Literature	N	0
3a	Sample A (Description)	Y	1
3b	Sample B (Justification)	Y	1
4a	Outcomes A (Reliability)	Y	1
4b	Outcomes B (Validity)	Y	1
5a	Intervention A (Description)	Y	1
5b	Intervention B (Contamination)	Y	1
6a	Results A (stat sig explained)	Y	1
6b	Results B (analysis method)	Y	1
6c	Results C (Importance for practice)	Y	1
6d	Results D (dropouts)	Y	1
7	Conclusion and implications	Y	1
	Total Points:		12/13

Study Name: 11. Evaluation of a national high school entertainment education program: The Alliance for Climate Education

Ref: (Flora, et al., 2014)

#	Section	Yes/No/ NA	Points
1	Study Purpose	Y	1
2	Literature	Y	1
3a	Sample A (Description)	Y	1
3b	Sample B (Justification)	Y	1
4a	Outcomes A (Reliability)	Y	1
4b	Outcomes B (Validity)	Y	1
5a	Intervention A (Description)	Y	1
5b	Intervention B (Contamination)	Y	1
6a	Results A (stat sig explained)	Y	1
6b	Results B (analysis method)	Y	1
6c	Results C (Importance for practice)	Y	1
6d	Results D (dropouts)	y	1
7	Conclusion and implications	Y	1
	Total Points:		13/13

Study Name: 12. Place-based inter-generational communication on local climate improves adolescents' perceptions and willingness to mitigate climate change Ref. (Hu & Chen, 2016)			
#	**Section**	**Yes/No/ NA**	**Points**
1	Study Purpose	Y	
2	Literature	Y	
3a	Sample A (Description)	Y	
3b	Sample B (Justification)	Y	
4a	Outcomes A (Reliability)	Y	
4b	Outcomes B (Validity)	Y	
5a	Intervention A (Description)	Y	
5b	Intervention B (Contamination)	Y	
6a	Results A (stat sig explained)	Y	
6b	Results B (analysis method)	Y	
6c	Results C (Importance for practice)	Y	
6d	Results D (dropouts)	Y	
7	Conclusion and implications	Y	(not related to behaviour)
	Total Points:		13/13

Study Name: 13. Raising Students Awareness to Climate Change: An Illustration With Binding Communication Ref. (Parant, Pascaul, Jugel, Kerroume, & Gueguen, 2017)			
#	**Section**	**Yes/No/ NA / Partly**	**Points**
1	Study Purpose	Y	1
2	Literature	Y	1
3a	Sample A (Description)	Y	1
3b	Sample B (Justification)	N	0
4a	Outcomes A (Reliability)	N	0
4b	Outcomes B (Validity)	Y	1
5a	Intervention A (Description)	Y	1
5b	Intervention B (Contamination)	n	0
6a	Results A (stat sig explained)	Y	1
6b	Results B (analysis method)	Y	1

6c	Results C (Importance for practice)	Y	1
6d	Results D (dropouts)	N	0
7	Conclusion and implications	y	1
	Total Points:		9/13

Study Name: 14. The impact of direct and indirect experiences on the development of environmental knowledge, attitudes, and behaviour

Ref. (Duerden & Witt, 2010)

#	**Section**	**Yes/No/ NA**	**Points**
1	Study Purpose	y	
2	Literature	Y	
3a	Sample A (Description)	Y	
3b	Sample B (Justification)	Y	
4a	Outcomes A (Reliability)	Y	
4b	Outcomes B (Validity)	Y	
5a	Intervention A (Description)	Y	
5b	Intervention B (Contamination)	Y	
6a	Results A (stat sig explained)	Y	
6b	Results B (analysis method)	Y	
6c	Results C (Importance for practice)	Y	
6d	Results D (dropouts)	Y	
7	Conclusion and implications	y	
	Total Points:		13/13

Study Name: 15. Environmental education policy of schools and socioeconomic background affect environmental attitudes and pro-environmental behaviour of secondary school students

Ref. (Monus, 2022)

#	**Section**	**Yes/No/ NA**	**Points**
1	Study Purpose	y	
2	Literature	y	
3a	Sample A (Description)	Y	
3b	Sample B (Justification)	Y	
4a	Outcomes A (Reliability)	Y	
4b	Outcomes B (Validity)	Y	
5a	Intervention A (Description)	Y	

5b	Intervention B (Contamination)	N	
6a	Results A (stat sig explained)	Y	
6b	Results B (analysis method)	Y	
6c	Results C (Importance for practice)	Y	
6d	Results D (dropouts)	Y	
7	Conclusion and implications	Y	Policy not intervention
	Total Points:		12/13

Study Name: 16. Assessing impacts of locally designed environmental education projects on students' environmental attitudes, awareness, and intention to act.

Ref: (Bergman, 2016)

#	**Section**	**Yes/No/ NA / Partly**	**Points**
1	Study Purpose	Y	
2	Literature	Y	
3a	Sample A (Description)	Y	
3b	Sample B (Justification)	Y	
4a	Outcomes A (Reliability)	Y	
4b	Outcomes B (Validity)	Y	
5a	Intervention A (Description)	Y	
5b	Intervention B (Contamination)	Y	
6a	Results A (stat sig explained)	Y	
6b	Results B (analysis method)	Y	
6c	Results C (Importance for practice)	Y	
6d	Results D (dropouts)	Y	
7	Conclusion and implications	y	Not climate change
	Total Points:		13/13

Study Name: 17: **The influence of an education program on students' environmental responsibility in developing countries: evidence from Iran**

Ref. (Nourmoradi, Asadi, Mehdi-Naghizadeh, Mazloomi, & Ghazanfari, The influence of an education program on students' environmental responsibility in developing countries: evidence from Iran, 2021)

#	Section	Yes/No/ NA	Points
1	Study Purpose	Y	
2	Literature	N	
3a	Sample A (Description)	Y	
3b	Sample B (Justification)	Y	
4a	Outcomes A (Reliability)	Y	
4b	Outcomes B (Validity)	Y	
5a	Intervention A (Description)	Y	
5b	Intervention B (Contamination)	Y	
6a	Results A (stat sig explained)	Y	
6b	Results B (analysis method)	Y	
6c	Results C (Importance for practice)	Y	
6d	Results D (dropouts)	N	
7	Conclusion and implications	Y	Not climate change
	Total Points:		11/13

Study Name: 18.Effective education for energy efficiency

Ref. (Zografakis, Menegaki, & Tsagarakis, 2008)

#	Section	Yes/No/ NA	Points
1	Study Purpose	Y	
2	Literature	Y	
3a	Sample A (Description)	n	
3b	Sample B (Justification)	Y	
4a	Outcomes A (Reliability)	Y	
4b	Outcomes B (Validity)	Y	
5a	Intervention A (Description)	Y	
5b	Intervention B (Contamination)	Y	
6a	Results A (stat sig explained)	Y	
6b	Results B (analysis method)	Y	
6c	Results C (Importance for practice)	Y	
6d	Results D (dropouts)	n	
7	Conclusion and implications	Y	
	Total Points:		11/13

Study Name: 19. Encouraging ecological behaviours among students by using the ecological footprint as an educational tool: a quasi-experimental design in a public high school in the city of Haifa Ref: (Gottlieb, Vigoda-Gadot, & Haim, 2013)			
#	**Section**	**Yes/No/ NA / Partly**	**Points**
1	Study Purpose	Y	
2	Literature	Y	
3a	Sample A (Description)	Y	
3b	Sample B (Justification)	Y	
4a	Outcomes A (Reliability)	N	
4b	Outcomes B (Validity)	n	
5a	Intervention A (Description)	Y	
5b	Intervention B (Contamination)	Y	
6a	Results A (stat sig explained)	Y	
6b	Results B (analysis method)	Y	
6c	Results C (Importance for practice)	Y	
6d	Results D (dropouts)	n	
7	Conclusion and implications	y	
Total Points:			10/13

5.3 Appendix 3: Studies excluded at full text review

Studies Excluded at Full Text Review

Reference	Exclusion and Inclusion Criteria Code
Ojala, M. (2020). To trust or not to trust? Young people's trust in climate change science and implications for	5 – review of empirical papers on topic

climate change engagement. *Childrens Geographies*. doi:10.1080/14733285.2020.1822516	
Stevenson, K., & Nils Peterson, M. (2015). Motivating action through fostering climate change hope and concern and avoiding despair among adolescents. *sustainability, 8*(1). Retrieved from https://doi.org/10.3390/su8010006	3 not related to CCE
Balunde, A., Perlaviciute, G., & Truskauskaite-Kuneviciene, I. (2020). Sustainability in Youth: Environmental Considerations in Adolescence and Their Relationship to Pro-environmental Behaviour. *Frontiers in Psychology*. Retrieved from https://doi.org/10.3389/fpsyg.2020.582920	3 not related to CCE
Jie Li, C., & Monroe, M. (2017). Exploring the essential psychological factors in fostering hope concerning climate change. *Environmental Education Research, 25*, 936-954. doi:10.1080/13504622.2017.1367916	3 – no CCE related aspect
Mead, E., Roser-Renouf, C., Rimal, R., Flora, J., Maibach, E., & Leiserowitz, A. (2012). Information seeking about global climate change among adolescents: The role of risk perceptions, efficacy beliefs and parental influences. *Atlantic Journal of Communications, 20*(1), 31-52. doi:10.1080/15456870.2012.637027	3-not a school based experiment
Shepardson, D., Niyogi, D., Choi, S., & Charusombat, U. (2011). Students' conceptions about the greenhouse effect, global warming and climate change. *Climatic Change, 104*, 481-507. doi:10.1007/s10584-009-9786-9	5 review of knowledge not behaviour
Valdez, R., Peterson, M. N., & Stevenson, K. (2018). How communication with teachers, family and friends contributes to predicting climate change behaviour	No intervention, strictly correlational

among adolescents. *Environmental Conservation, 45*(2), 183-191. doi:10.1017/S0376892917000443		
Alexander, R., & Poyyamoli, G. (2017). Climate change education for school students-activity-based teaching learning approach to create knowledge, attitudes skills and behavioural change. *International Journal of Global Warming, 12*(3-4), 431-447. doi:10.1504/IJGW.2017.10005894	paper	No way to access
Boyes, E., & Stanisstreet, M. (2011). Environmental education for behaviour change: Which actions should be targeted? *International Journal of Science Education, 34*(12), 1591-1614. doi:10.1080/09500693.2011.584079		Correlational
Eggert, S., Nitsch, A., Boone, W., Nuckles, M., & Bogeholz, S. (2017). Supporting students learning and Socioscientific reasoning about climate change- the effect of computer-based concept mapping scaffolds. *Research in Science Education, 47*, 137-159. doi:10.1007/s11165-015-9493-7		3- no cce
Cordero, E., Centeno, D., & Todd, A. M. (2020). The role of climate change education on individual lifetime carbon emissions. *PloS ONE, 15*(2), 1-23. doi:10.1371/journal.pone.0206266	1-	Sample third level
Jackson, L., & Pang, M. F. (2017). Secondary school students' views of climate change. *International research in geographical and environmental education*, 1-13. doi:10.1080/10382046.2017.1330036		Qualitative
Lehnert, M., Fiedor, D., Frajer, J., Hercik, J., & Jurek, M. (2019). Czech students and mitigation of global warming: beliefs and willingness to take action.	CCE	Not experimental no

Environmental Education Research, 1-26. doi:10.1080/13504622.2019.1694140	
Robelia, B. A., Greenhow, C., & Burton, L. (2011). Environmental learning in online social networks: adopting environmentally responsible behaviours. *Environmental Education Research, 17*(4), 553-575. doi:10.1080/13504622.2011.565118	No school or explicit education aspect
Vazquez-Vilchez, M., Garrido-Rosales, D., Perez-Fernandez, B., & Fernandez-Oliveras, A. (2021). Using a Cooperative Educational Game to Promote Pro-Environmental Engagement in Future Teachers. *Education Sciences, 11*(691), 1-18. doi:10.3390/educsci11110691	Qualitative
Manoli, C., johnson, B., Hadjichambis, A., Hadjichambi, D., Georgiou, Y., & Ioannou, H. (2014). Evaluating the impact of the Earthkeepers Earth education program on children's ecological understandings, values and attitudes, and behaviour in Cyprus. *Studies in Education al Evaluation, 41*, 29-37. doi:http://dx.doi.org/10.1016/j.stueduc.2013.09.008	Not directly related to climate change
Ali Khan, N., Karpudewan, M., & Annamalai, N. (2021). Moving beyond the one size fits all model in describing the climate conserving behaviours of Malaysian secondary students. *Sustainability, 13*(18), 1-20. Retrieved from https://dx.doi.org/10.3390/su13010018	Correlational, no educational intervention
Yang, B., Wu, N., Tong, Z., & Sun, Y. (2022). Nature-based environmental education improves environmental awareness and environmental attitudes. *Environmental Research and Public Health, 19*, 1-19. doi:https://doi.org/10.3390/ijerph19116483	Environmental education, no climate change education mentioned

Chen, K. H. (2019). Transforming environmental values for a younger generation in Taiwan: A participatory Action Approach to Curriculum Design. *Journal of Future Studies, 23*(4), 79-96. doi:10.6531/JFS.201906_23(4).0008	aged	Cohort university
Ronaghi, M. H. (2022). The effect of virtual reality technology and education on sustainable behaviour: a comparative quasi-experimental study. *Interactive technology and smart education*, 1-18. doi:http://dx.doi.org/10.1108/ITSE-02-2022-0025		University cohort
Johnson, B., & Činčera, J. (2021). Relationships between outdoor environmental education program characteristics and children's environmental values and behaviours. *Journal of Adventure Education and Outdoor Learning*, 1-19. DOI: 10.1080/14729679.2021.2001756	change	Unrelated to climate

5.4 Appendix 4: Brief review of excluded studies

Altogether, 10 studies were excluded from the final literature based on their low scores in the Modified McMaster critical review form. The majority of these were excluded either because of the type of sample they included, the type or quality of climate change education intervention included, or because of the outcome they were measuring. Despite this, many interesting findings related to climate change behaviour were identified. A study on the effects of binding communication in relation to a once-off, 2 hour long climate change presentation (Parant, Pascaul, Jugel, Kerroume, & Gueguen, 2017) suggests that if secondary school participants write down three concrete actions that they would be willing to take to lessen their carbon footprint they were 4 times more likely to carry out a specific climate change related behaviour following the presentation. Another study considered the effects of a short-term environmental programme that took place over one day (Sellman & Bogner, 2013). This study notes that many education-based interventions are based around short term programmes because of how they match secondary schools' curricular needs but that these programmes are less likely to have any persistent attitudinal or behavioural effects.

Several studies also considered the type of classroom instruction and how it might affect student's pro-climate behaviour. A primary school study (Sumrall & Sumrall, 2021) considered classroom activities that would increase participants' locus of control around climate change mitigation and adaptation strategies. It found that letter writing together with quantifying the student's own reduction of carbon emissions were two helpful tactics in bringing about widespread behavioural change. Another, second level study (Gottlieb, et al., 2013) highlighted how the development of a school level carbon footprint and eco-footprint was conducive to behavioural change in the students who took part in the activity.

Other studies considered the role of people or places in CC involvement and mitigation. A one-week long intervention that took place in a nature reserve focused on

explaining climate change through hands-on, real-world learning in a local context (Khadka, Lie, Stanis, & Morgan, 2021). Another largescale study (Hu & Chen, 2016) discussed in the review also considered how intergenerational learning based in local scenic spots impacts on adolescent concern and behavioural change. Both of these studies found that participants who had taken part in the intervention more willing to support climate change mitigation measures or make personal changes to their own lifestyles. Khadka et al's study (2021) also found an impact on the degree of hope for the future that participants exhibited after taking part in intervention. Previous studies have noted how students who have hope for the future are more likely to engage in behavioural change than students who despair over about climate change (Ojala, 2012) (Jie Li & Monroe, 2017) (Stevenson & Peterson, 2015).

Finally, three other studies (Bergman, 2016) (Monus, 2022) (Gottlieb, et al., 2013) considered the effects that schools' environmental policies and mainstream environmental curricula might have on aspects related to climate change. These studies showed that schools that took part in generalised environmental programmes that didn't include the socio-economic reasons for climate identified knowledge and awareness increases but little in the way of attitudinal or behavioural change. Schools with more specific, in-depth programmes led to more behavioural change. Bergman's study (2016) suggested that general green flag or environmental education programmes didn't affect behaviours related to climate change, no matter the age of the students. Monus' study (2022), suggested that a change in behaviour is more evident in older (17-18y/o) students but only in schools with specific sustainability measures in place on a school wide basis.

5.5 Appendix 5: Behavioural Theories and Models (expanded)

Earlier behavioural theories related to the environment drew heavily on Rational Choice Theory stemming from the classical economics theories (Prager, 2012). Theories such as the Theory of Reasoned Action (Azjen & Fishbein, 1980) and the Theory of Planned Behaviour (TPB) (Ajzen, 1991) consider humans as rational beings who make systematic use of all available information to come up with an intention to perform a given behaviour (See Figure 3). Earlier environmental behaviour models, such as the Hines Model of Responsible Environmental Behaviour (Hines, 1987) follow these models. The available information used consists of 3 main categories, the attitude towards the behaviour, subjective norms connected to the behaviour and perceived behavioural controls (Ajzen, 1991). Using this theory, a positive environmental action occurs when a person holds a positive attitude towards that action, if there is an expectation and support from others that they act in that way and if they think that they have the efficacy needed to complete the action. While the structure of this theory has been supported in relation to research on different environmentally friendly behaviours such as choosing eco-hotels (Han, Hsu, & Chwen, 2010) or recycling behaviours (Tonglet, Phillips, & Read, 2004), the theory itself has been criticised for equating the intention to perform a behaviour with the behaviour itself (deGroot & Steg, 2007), for the fact that a person's different values often fail to adequately predict specific behaviours (Schultz, et al., 2005), and for its inability to predict habitual behaviours (Klockner & Blobaum, 2010).

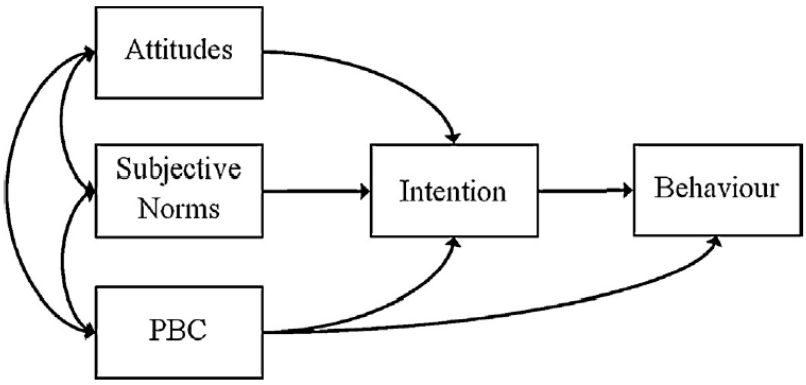


Figure 12: Theory of Planned Behaviour (Ajzen, 1991, quoted in Klockner, 2012)

Theories such as TPB that are based on the concept of rational choice are premised on the idea that people will behave in ways that maximise the expected benefits they will receive from any action taken. A large body of research identifies non-self-interested value orientations to pro-environmental behaviour however (Heberlein, 2012; Payne, 2000). These orientations include factors such as environmental identity (Riggs Stapleton, 2015) pro-social (Jackson T. , 2005) and biospheric (Dunlap, Van Liere, Mertig, & Jones, 2000) value orientations. This has given rise to the Norm Activation Theory (NAT) which is premised on the idea that a person's moral identity will cause them to act pro-socially or in order to avert a threat to others (Schwartz & Howard, 1981) or pro-environmentally (Thøgersen, 1996).

Value Belief Norm Theory and the New Environmental Paradigm

The TPB and NAT have, in turn, given rise to the Value-Belief-Norm (VBN) theory of environmentalism (Stern, 2000), that links Value Theory, NAT and the New Environmental Paradigm (NEP) perspective to explain four categories of pro-environmental behaviour activism, nonactivist public-sphere behaviours, private sphere behaviours and behaviours in organisations (see figure 4). Within the VBN model, a person's values form the basis for whether or not they believe their behaviour impacts the environment. If a person has high biospheric values, that is they feel connected to and care for nature and the environment, they are more likely to have a strong environmental self-identity (de Groot & Steg, 2007).

Environmental self-identity signifies the extent to which a person sees themselves as someone who acts in an environmentally friendly way (van der Werff, Steg, & Keizer, 2013). These beliefs lead to the formation of personal norms such as the intention to act pro-environmentally. This in turn leads to environmental behaviours both at home (recycling) and in public (joining a climate change march). Research based on the VBN model has shown strong links between biospheric values and environmental self-identity and different environmental behaviours such as recycling (Balunde, Perlaviciute, & Steg, 2019), environmentally friendly travel (Unal, Steg, & Granskaya, 2019) and purchasing sustainably produced goods (Balunde, Perlaviciute, & Truskauskaite-Kuneviciene, 2020).

The Value Belief Norm model focuses on how environmental attitudes and, in turn, behaviours, can be influenced by a person's awareness of harmful consequences to valued objects (see figure 13). Stern et al (2000) classify valued objects as being oriented around three different sources, the self (egoistic), other people (social altruistic), or all living things (biospheric). A person's attitude to the environment will be influenced through the dominant values source of that attitude. For instance, an egoistic environmental attitude might be concerned about climate change because their own house might be at risk of flooding. A person with a biospheric attitude might care about preventing climate change simply because all living things are at risk because of it.

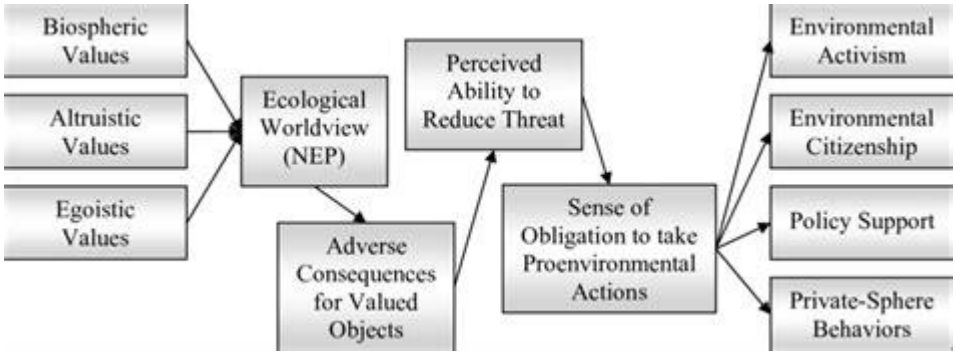


Figure 13: The Value-Belief-Norm Theory of Environmentalism (Stern, 2000)

Social Practice Theory

Both the TPB and VBN models have been widely criticised (Klockner & Blobaum, 2010) (Ouellette & Wood, 1998) (Verplanken & Aarts, 1999) as not differentiating between habitual and infrequent behaviours. A habitual behaviour refers to a behaviour with an enduring cognitive orientation which makes an individual less responsive to new information presented about a topic (Ouellette & Wood, 1998). Consequently, strong habits act as a moderator between personal norms and environmental behaviour changes (Klockner, Matthies, & Hunecke, 2006). In other words, for a behaviour performed infrequently, such as choosing to buy an electric car instead of a carbon emitting car, a person's intentions will have a strong influence, while past behaviour will have a weak influence. For a frequent behaviour however, such as choosing to use a keep cup instead of a disposable cup, the reverse is true. There are several theories generally found under the ambit of Social Practice Theory (SPT) (Bourdieu, 1977) which suggest that social practices, habits and routines are as much determinants of behaviour as internal factors. According to SPT, a person's environmental behaviours are not determined by a person's cognition, efficacy level or belief, rather by the person becoming the "carrier" of social practices and the "performer" of behaviours that are required by a particular social practice (Reckwitz, 2002 as cited in Reed & Page, 2016). Generally, such contextual theories can be considered as more nomothetical

compared to the VBN model's idiographic approach. Reed and Page (2016) point out that both theoretical perspectives are both essentially reductionist in that their focus is on understanding specific factors or variables that influence environmental behaviour.

Mixed models

There are several other models such as the Comprehensive Action Determination Model (CADM) (Klockner & Blobaum, 2010) which combine the attitudes, personal norms, social norms, habits and perceived behavioural control of previous models and identify proximal and distal predictors of environmentally relevant behaviour. In their work linking behaviour change techniques and behaviour change determinants, Michie et al (2008) propose a list of variables as the key determinants of behaviour change (See Figure 14). However, as is highlighted in different systematic reviews (Kollmuss & Agyeman, 2002; Klockner, 2013), all theoretical frameworks can have some validity depending on the circumstances. Kollmuss & Aygeman (2002) argue that different models can be useful in highlighting the complexity of changing environmental behaviours, but are less useful in attributing direct, causal relationships between the different internal and external factors and a given behaviour. From an empirical perspective, this is concerning, in light of the number of peer reviewed papers related to both schools (Nongqayi, Risenga, & Dukhan, 2022) and businesses (Sadler-Smith, 2015) that consider the direct role that knowledge about climate change plays in encouraging pro-environmental behaviours when the evidence suggests that it only plays a role in attitudinal change rather than behavioural change (Duerden & Witt, 2010; Wen & Lu, 2013; Jurek, et al., 2022; Stevenson, Peterson, & Bondell, 2018). Some research has been undertaken that considers the psycho-social determinants of pro-environmental behaviour (Bamberg & Moser, 2007; Hines, Hungerford, & Tomera, 1987). The three key factors which predict pro-environmental action are, unsurprisingly, pro-environmental behavioural intention, pro-environmental attitude, locus of control and

personal moral norm. Environmental knowledge and problem awareness don't directly determine pro-environmental behaviour but are indirect factors in pro-environmental intention.

Environmental Citizenship Behaviour Model

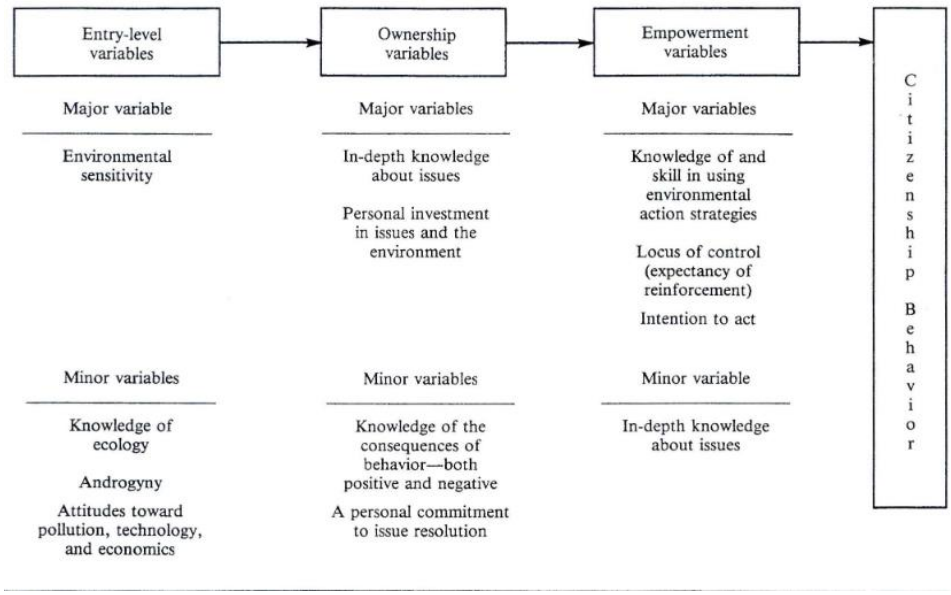


Figure 14: Major and minor variables involved in Environmental Citizenship Behaviour model (Hungerford & Volk, 1990)

Hungerford and Volk (1990) developed the Behaviour Flow Chart that identified three categories of variables that contributed to environmental behaviour. A later paper (Hungerford H. R., 1996) explained in more detail how each of the levels – entry level variables, ownership variables and empowerment variables interact in a linear fashion with each other to produce pro-environmental behaviour (see figure 4. In short, entry level variables involve the degree to which someone is sensitive to their environment as well as general knowledge and attitudes they hold about environmental issues. Ownership variables reflect the concept that a person must psychologically "own" the issues that they are working on in an educational environment through investing their time and effort into an environmental issue after gaining an in-depth knowledge of that issue. This stage is said to occur only after a person has personally identified a particular issue as an area that they have

a proprietary interest in from already having knowledge and acting in that area. The final level of this model is called the Empowerment variables level. As the name suggests, this level consists of variables that give human beings a sense that they can make changes and help resolve key environmental issues in the world.

5.6 Appendix 6 - Lesson plans for modules

Duration of modules

This intervention consists of four 2-2.5-hour modules. These modules can take place over the course of 2 half days or else over 4 sessions. Other climate change education programmes of this duration have been found to be effective in increasing the agency of participants (Sezen-Barrie, Miller-Rushing, & Hufnagel, 2020), and improved their critical thinking about climate change (Karpudewan & Mohd Ali Kahn, 2017). Other research suggests that participation in any climate change education activity increased engagement with climate change related behaviours (Lester, Ma, Lee, & Lambert, 2006).

Contents of modules

The material itself, in particular the activity based, student led methods together with the module design is aimed at increasing pro-environmental behaviour and meaningful coping with climate change as was the case with other studies (Hermans & Korhonen, Ninth graders and climate change: Attitudes towards consequences, views on mitigation, and predictors of willingness to act). The material is based on themes identified in the development of a short course on climate change developed by Irish teachers (Minnock, Sullivan, & Dick, 2021) The material aims to connect students with local climate change impacts and encourage students to collect information and discuss and draw conclusions together from the collected material which foster ownership at a student level over local climate change initiatives (McNeal, Petcovic, & Reeves, 2017) while also improving young people's views on their capacity to effect change on individual and local levels (Ross, Rudd, Skains, & Horry, 2021) (Rudd, Horry, & Skains, 2020).

Research will be guided by the PSI's Code of Ethics (Psychological Society of Ireland, 2019) as well as the Data Protection Act (2018). All materials used by students will follow the Universal Design for Learning Principles also in that material will be explained in such as way so that all students are able to complete the survey forms and take fully take part in the intervention. (Hall & Murray, 2010).

Learning objectives and core skills for CCEP

The modules focus on facilitating and empowering young people to become confident and informed climate change actors on climate change issues. By the end of the programme, participants should:

- Have improved communication skills
- Have improved group work and facilitation skills
- Have an understanding of climate change causes and effects
- Take action with their peers and family to combat climate change

The core skills

Module 1: Intro to Climate change, causes of climate change, climate change causes in Ireland.

Module 2: Intro to ecosystems; Climate Change effects on eco systems in Ireland and the world, tipping point for climate change

Module 3: Climate Change mitigation and adaptation strategies – identifying Individual, family, local, national, international.

Module 4: Coping with climate change – a change in mentality, a change in behaviour.

Sample Schedule for Climate Change Intervention – Module 1 (Words highlighted in blue are links to resources)						
#	Name and duration	Type	Resources Needed	Description	Aim	References
1	Which picture do you prefer? 20 mins	Ice-breaker Group Based Facilitator Led	4 pictures	1: Students form into groups 2: Students are given 4 pictures, one of an industrial scene, one of a natural scene, one of urban sprawl, one of planned urban living 3: Students are asked to write 2 benefits and 2 drawbacks of living in a place that is like each of the pictures. 4: Facilitator explains that 65% of people live in cities. Asks are people living in rural or urban areas happier; afterwards mentions the benefits found by researchers	An easy icebreaker aimed at students quickly understanding the health benefits of immersion in the natural world	Groups will be guided through the determinants of health as per Barton and Grant's health map for local human habitats (Barton & Grant, 2006) that is based on social-ecological systems theory which describes the interaction between humans and nature on different levels (Van Assche, Verschraegen, Valentinov, & Gruezmacher, 2019)
2	Living with nature is a balancing act! 35 mins	Group based Student led	Pictures, Chart Markers	1: Students are asked which environment in the pictures that they would prefer to live in. 2: Results are put on a graph on the wall. 3: Facilitator asks what would happen if the number of people who picked the nature scene to live in moved there. 4: Facilitator asks what would happen if nobody wanted to work or live in industrial scene, highlights it would revert to nature using picture of Chernobyl 5: introduce the idea of balance 6: Ask groups to discuss what their ideal balance would be between living with modern comforts and living with nature 7: Ask groups to brainstorm how their communities could go from urban sprawl picture to living with nature picture	Exploring the balance that we need to maintain between the natural and industrial worlds Exploring the internal balance between our indoors and outdoors environments Understanding how the	More socio-ecological theory (Van Assche, Verschraegen, Valentinov, & Gruezmacher, 2019) Affective benefits of exposure to nature are explored by Bratman, Olvera-Alvarez, & Gross, (2021). Cogntive benefits for students are explored by Mason, Scrimin, et al. (Mason, Ronconi, Scrimin, & Pazzaglia, 2021) Understanding the importance of loosening the boundaries between indoor and outdoor spaces both for learning (Dhanapal & Lim, 2013) and for living and mental health (Pasanen, Tyrväinen, & Korpela, 2014)

				8: Ask to brainstorm what they can do as students to achieve this	human world is a part of the natural world, not separate to it	
3	Introducing Climate Change 30 mins	Groups Individual activity Multimedia activity	PowerPoint Words written on piece of paper YouTube video	1: Explain climate change as an example of humans being out of balance with nature 2: Ask groups when they think this started to happen, then why it started to happen, why it continues to happen 3: Explain concept of progress, how all development and progress is based on resources, how economic systems treated natural resources as infinite when they are not Show the video "man" : https://www.youtube.com/watch?v=WfGMYdalClU 4:	Exploring the causes of climate change Differentiating between climate change as an issue and other environmental issues Linking environmental issues to climate change	Main areas to include and not to include for introducing climate change in secondary schools were found in Meehan et al (2018) The role that teachers play in teaching about climate change was considered through reading (Li, Monroe, Oxarart, & Ritchie, 2021) and Howard-Jones et al (Howard-Jones, Sands, Dillon, & Fenton-Jones, 2021) Consideration was given to both Academics' perception of how sustainability should be taught at secondary level in Europe (Burgland, Gericke, & Chang-Rundgren, 2014) (Cebrian, Pascual, & Moraleda, 2019), as well as teachers experiences of teaching sustainability (Sund, 2016) and classroom features associated with learning about sustainability (Yli-Panula, Jeronen, & Lemmetty, 2020)
4	Science behind climate change 20 mins	Group work		Explain the difference between other environmental issues and climate change by asking groups to sort words into environmental issues v climate change issues v both 5: identify increase in greenhouse gases as the main cause of climate change 6: Ask individuals to match up different greenhouse gases to explanation of them on worksheet	Understanding how climate change can occur as a result of manmade activities as well as	These papers were useful in informing the research on how to both differentiate between and link climate change and environmental degradation when teaching climate change education. They were also useful in the researcher gaining an insight into socio-cultural factors that lead to different beliefs around climate change: (Whitmarsh, 2008)

				6: Ask groups to identify causes of climate change 7: Ask group to identify all of the different ways that humans affect production of greenhouse gases after watching the video about the destructive effects of consumerism https://www.youtube.com/watch?v=JyL58vlbvgw	natural activities but that manmade activities are having a much greater affect now Identifying the causes and effects of climate change	(Punter, Ochando-Pardo, & Garcia, 2011) (Boyes, Skamp, & Stanisstreet, Australian secondary students' views about global warming: beliefs about actions, and willingness to act, 2009) (Bodzin & Qiong, 2014) (Hesse-Biber, 2019) (Dawson, 2015) (Kellstedt, 2008)
4	Climate change in Ireland and in the world 25 mins	Facilitator led for instructions student led for all activities	True or false round Quiz questions Red and green paddle	1: Do true or false round using the statements in worksheet. Ask participants to hold up red paddle when false, green when true 2: Show students the infographic about Ireland compared to other EU countries on CC. Ask them their thoughts on Ireland's place in the list 2: Take list of climate changes causes in the EPA infographic, ask groups to think of concrete examples of actions for each of the different areas 4: Ask groups to brainstorm how each area causes climate change. Put up on board: electricity/heat Manufacturing Construction Industrial processes Transportation Agriculture Water and waste treatment	Recap of causes Exploring climate change in Ireland Exploring whether Ireland's role is less than other countries roles to play in combatting climate change	This is based on experiential learning principles which are shown to have an effect on attitudes towards and knowledge increase about climate change (Karpudewan & Mohd Ali Kahn, 2017) (Pruneau, Gravel, Bourque, & Langis, 2003) The need for participatory, creative approaches to climate change education was informed by Rousell and Cutter-Mackenzie-Knowles' review (2020) Use statistics from CSO on climate change: https://www.cso.ie/en/releasesandpublications/ep/p-eii/eii18/greenhousegasesandclimatechange/

Sample Schedule for Climate Change Intervention – Module 2 Ecosystems and tipping points						
#	Name and duration	Type	Resources Needed	Description	Aim	References
1	Splat the Keyword 15 mins	Ice-breaker Group Based Facilitator Led	Computer Projector Two swatters	1: Students form into three groups. Each of the team members gets a number 2: The key words are presented on the board in different locations for the three teams. The list of keywords are chosen from page 86 of this Eco UNESCO document 3: Facilitator reads out a series of clues related to the word. These clues can either be definitions of the words, short explanations, complete the sentence or other clues. The team member can either swot the word by themselves or take hints from their team members as to what the word is. 4: After each success the team members change places. 4: If a student uses the word in a sentence, then they get a bonus point	An easy icebreaker aimed at checking students understanding of key terms related to climate change	Groups will gain an understanding of key words relating to climate change and ecosystems based on the UNESCO Youth for the Future resources (ECO UNESCO, 2010)
2	Web of life 25 mins	Group activity Facilitator led	String Picture Cards of organisms	1. Split the class in to two groups 2. Ask the groups to stand in a circle 3. Ask the class if they know what an ecosystem is. Explain after listening to responses that there are relationships between different plants and animals and other organisms in an ecosystem. They all	Understand an ecosystem as the interconnectedness between different things	The activity comes from the Youth for the Future handbook (ECO UNESCO, 2010). The ideas about ecosystems and human impact on the eco system stem from the principles identified by

				rely on each other for food and shelter. This is the web of life which we will create. 4. Give each participant a picture card. Whoever gets the picture card of the human stands in the middle. Ask the participants to hold their card outward so everyone else can see them also 5. Give the ball of string to one of the participants and ask them to hold the end of the string and pass the ball to someone in the group that holds a card that connects in some way to theirs. i.e., the blackbird will connect to the worm because it eats it. The worm will connect to the compost because it lives in it 6. The next person in turn passes the string to a different plant/animal to which they are connected. This continues until all the participants are linked up by a web and where a complex web has been created. 7. Ask the participants to reflect on what they have created. Ask what the web shows (that there are interconnections between plants and animals in an ecosystem. 8. Next, ask one participant to sit on the ground. Ask if anyone feels their string being pulled down as a result. If so, they too must sit on the ground. This continues and eventually the web is taken to the ground. 9. Ask the group what this demonstrates (answer: that if something happens to one species, it can affect all the other species in the ecosystem) 10. End with a discussion of where the human in the middle fits into the eco system. DO they have a positive or negative effect on	Understand why biodiversity is important to climate change, understand humans place in different eco systems	the Transition Network (2021) as important for a sustainable and just society. The game is adapted from an earlier version by Movement Generation document which was also used to define the principles underpinning human involvement in an ecosystem (Movement Generation, 2022) The relationship between understanding ecosystems and climate change at secondary school level is explored by Balgopal et al., (2014)

				the eco system? Now link each organism with the person in the middle and ask them to sit down. See the role that humans can play.		
3	The body earth metaphor 25 mins	Roleplay – one person in front of the class	Articles of clothing – jacket, hoodie, winter jacket, hat, scarf, gloves Pictures of the following	1. Call up a pre-selected volunteer who is in on the plan 2. Ask them how they would feel if they only had shorts and a t shirt on. The response should be cold 3. Read part 1 of the script 4. Ask the person to start jumping and then running on the spot. Remember to check in with them and ask them how they are doing. They should answer that they are getting warm. 5. Read off from the list of ecologically damaging activities: fossil fuels, industry, electricity, tox and waste production, industrial agriculture, soil erosion. Compare each of these to a different body function – lungs (forest) Circulatory system (water, sea, rivers)Nervous system (biodiversity) immune system – climate change getting hotter) 6. After each reading give the volunteer more clothes to put on and increase the pace of the activity that the person is doing 7. When the person asks for some water, you explain as they are the earth they must use the water that they have in and on them only. 8. After they are exhausted let them stop	To explain how the human body is a really good model of the earth. To demonstrate how, just like the earth, your body is a living system made up of interdependent living systems To show how humans are an integral part of the earth system To use the body metaphor to demonstrate the extent of energy and ecological destruction	https://movementgeneration.org/wp-content/uploads/2014/08/Body-Earth-Metaphor-2014.pdf Workshop was originally designed by Choy (2014) to demonstrate how humans are an integral part of the Earth's ecosystem while also demonstrating the extent of energy and ecological destruction. Material on biodiversity was informed by the activities and perspectives in the Government of Canada's *The Big Picture on Biodiversity and Climate Change* document (Watkins & Halton, 2010)
4	The tipping point	Facilitator led – two volunteers needed	1 clear plastic cup filled	1. Put table in a place where all students can see it. Ask the students in their groups to write down what they think a tipping point is	To understand a sense of the scale of the ongoing	This version of the tipping point is taken from the Movement Generation's handbook (Choy, 2014)

	25 minutes		with water 1 clear plastic cup filled with corn kernels Table chair	2. Ask each group to explain their answer 3. Explain that the cup of beans represents a tipping point. Explain that eco-systems can be big or small and that they help create and sustain life on Earth. Eco-systems have to be in balance. Ask if the cup is balanced or not 4. Next explain that with every eco system you can apply some pressure but that the cup will return to a stable point . Push the cup over a little bit a few times. 5. Ask the class to tell you when to stop pushing over the cup. Keep getting them to encourage you to push it over more and more until it falls over. 6. Explain When you push a system past its tipping point it will continue to change until it finds a new way to be/exist – a new state of balance- EVEN if you stop pushing it. Point out that once the cup past the tipping point, taking away the finger didn't change anything. It has fundamentally changed from a cup of beans to a mess. (pick up the beans and put the cup away) 7. Explain that the planet also has different tipping points. Explain that there are 9 or 10 tipping points From cards) use the example of the amazon rainforest. Explain that deforestation and burning lead to a large tip. 8. Next ask for a volunteer and ask them to sit down in a chair in front of a class with their hands on their lap. Place the cup of water on their lap and explain that you want to find the tipping point of this system. Explain that you will do the same as what you did	climate change crisis To link the loss of eco systems to climate change To illustrate and explore relationships of power and proximity to consequences	The concept of climate tipping points as times of rapid change in the environment are explored in depth in this Nature article (Lenton, et al., 2019) / The approach to this game was also informed by and will include the relationship between southern actors (indigenous activists, island nations, groups seeking climate justice), concepts such as accountability and reciprocity and tipping points (Whyte, 2019) Linking the loss of eco-systems to climate change can be quite complex as you have to consider the interaction between key elements such as CO2 concentrations, ocean acidification, chemical composition in the air as well as degradation, fragmentation and defaunation of land (Malhi, et al., 2020). While this will not explicitly be covered it will be mentioned during this exercise and a worksheet from the EPA in the US will also be handed out to any students who are interested in learning more about this area An alternative tipping point explanation that involves the whole group and goes into more depth and is linked more directly with

				with the beans except only the person in the chair can tell you when to stop pushing. 9. Push the cup a few times without spilling over the water. Explain that the person living with the direct consequences of pushing the system too far will be a lot more conservative about how much they want the system to be disturbed 10. Next ask the group whether I could have pushed the system further before it would have fallen. They will say yes. Ask the volunteer why they wouldn't let you and they'll say because they didn't want to get wet. Ask the class what is happening and why are the consequences different for them as opposed to the volunteer.		biodiversity can be found on page20-24 here
5	Discussion	Group based Student led	A3 paper, markers Green and red boards	1. Ask the groups what they think about the following statements by holding up a true or false panel: • Humans are separate from nature • Technology will provide the solution to climate change • Natural resources are infinite • The ecological crisis is far away • The earth is not in crisis (its humans who are) • Poor countries have the right to develop just the way that the west has After each one ask the students to explain their answer in terms of their learning today about ecosystems	To identify how students have assimilated the modules learning into their climate change schemas	The idea of analysing practical work to assess an increase in knowledge and abilities is discussed in this book (Millar, 2009)

Module 3: Climate Change mitigation and adaptation strategies – identifying Individual, family, local, national, and international solutions						
#	Name and duration	Type	Resources Needed	Description	Aim	References
1	Alphabet Race Energiser 15 mins	Group based Active exercise	A3 paper, markers Blu-tack String/tape	1. Split the class into teams of between 3 and 4 people 2. Stick up the flip chart paper at one end of the room 3. Make a start line at the other end of the room using the tape 4. Each team lines up in single file behind the start line 5. Give the first person in each group a marker and explain that the activity is a relay race 6. Explain that each team has to work together to come up with a word connected to sustainable development or climate change that begins with every letter of the alphabet 7. The first person runs to the sheet, writes down a word for A and runs back, handing the pen to the second person and going to the back of the line. The next person takes the marker and runs down to write a b word and so on. 8. Once all the teams are finished swap the sheets around and ask them to	To identify what the participants now know and need to know about climate change To move from an explanation to a solution focused model	A simple warm up game found in Eco-UNESCO's Climate Change module (ECO UNESCO, 2010)
2	Minimising the repercussions of climate change 20 mins	Small groups of 3 Student led	A3 paper Markers, Worksheets Venn Diagram	1. Place students in groups of 2 or 3 2. Ask students if they have heard of the word's adaptation or mitigation. Ask them to provide definitions if they think they know what they mean. 3. Give each group the NASA definition text and ask them to come up with as simple a definition of each word as possible in their groups 4. Put two signs up on either end of a wall: "impacts of climate change" and "actions to combat climate change"	To ensure students know the difference between adaptation and mitigation To be able to provide examples of adaptation	Definitions are simplified versions of those contained in the IPCC's document Climate Change 2014: Mitigation of Climate Change (IPCC, 2014) The impacts of climate change in different parts of the world were informed by this IPCC paper (IPCC, 2014)

				5. Pass out different prompts to students. Ask students to discuss what the prompt says with their partner and stick the prompt on the wall in a place that that they think reflects where the prompt is best situated. 6. Afterwards, draw a Venn diagram on the board which has mitigation, adaptation or both as the categories. Hand out the Venn diagram worksheets also. Ask the students to place the actions to combat climate change into different areas on the Venn Diagram. 7. Explain the two terms using the following: Mitigation involves reducing the severity or seriousness of a problem. We can mitigate the effects of climate change by creating more fuel-efficient vehicles or using renewable energy. Adaptation means adjusting to new conditions. This means that the effects are already occurring. We can adapt to a changing climate by making upgrades to sewer systems for increased rainfall during storms. These actions will lead to more resilient communities therefore allowing those communities to recover quicker from the repercussions of climate change.	and mitigation on different societal levels	The first activity was adapted from an activity developed by a US NGO working on climate change education. This NGO, Climate Generation, aims to personalise and localise climate change action and has developed a series of climate change education modules for the US schools system. The activity was adapted to the Irish context The importance of understanding adaptation and mitigation and the role that second level education has to this end is highlighted by (Feinstein & Mach, 2019). Other papers (Stevenson, Nils Peterson, & Bondell, 2018) (Stevenson & Nils Peterson, 2015) (Ojala, Hope and climate change: The importance of hope for environmental engagement among young people, 2012) (Otto, Evans, Moon, & Kaiser, 2019) highlight the importance of using solutions focused techniques to retain hope for the future when teaching about climate change in the expectation of behavioural change.

3	Understanding who is responsible for mitigation and adaptation 30 mins	Individual first Small groups of three Facilitator led	A3 paper Markers in four different colours Worksheets	1. Hold a group discussion to identify different stakeholders. Start by asking who will be affected by climate change. After some people say everybody ask them to try to define the different groups. Now ask them to identify who can resolve the climate change issue. After giving their answers ask them why the solution isn't with everybody in the same way the problem is. 2. Explain that sometimes when you have a messy problem it's easier to reach a solution about the problem by drawing it out. 3. Ask the students to form groups of two or three. 4. Ask students to write down all of the different groups they can think of that will be affected by covid, starting with themselves. The following should be included: - ME - My family - My community - Irish Businesses - International Businesses - Farmers - Politicians - Activists - School Community 5. Explain that you would like to make a rich picture map that shows the links between all of the different stakeholders mentioned above. Distribute some examples of rich pictures and highlight how different circles are in different sizes, how there are direct or indirect lines	Understanding how different stakeholders are impacted by climate change and also the role that different stakeholders can play in combatting climate change	This is the first time that climate change justice is discussed in detail, but this theme will run throughout modules 3 and 4 while also being mentioned in module 2. Important issues that will be raised both implicitly and explicitly include: Sharing the cost of climate change mitigation (Moellendorf, 2015) Sharing technology for climate change adaptation (Page, 2013) Environmental Activism (ECO UNESCO, 2010) Sustainable consumption (Helm, 2011) Environmental Governance (Stripple & Stephan, 2013) This exercise is based on some aspects of soft systems methodology (Checkland & Poulter, 2006), in particular the rich picture method (Armson, 2011) (van der Goot, Cristancho, de Carvalho Filho, Jaarsma, & Helmich, 2020) This method uses imagery, symbols and interactions to highlight the complexity of a situation and also how an

				between different stakeholders, how some connections are bigger than others. Then highlight how all of these different people or groups of people have an effect, either positive or negative on all of the other groups. Ask them to create a picture showing all of these different connections between stakeholders. 6. (time permitting follow up with this step) Once they have completed this task ask them to make another rich picture that takes one of the actors mentioned above and highlights the ways they are responsible for climate change (based on the actions outlined in the first module) 7. Follow this up with identifying the different ways that those groups can take responsibility for mitigating or adapting to climate change.		individual or community engages with that complexity. Instructions for the rich picture task were taken from Armson (2011). Systems thinking's application to ecosystems and sustainable development informed by Saja Sanneh's book on systems thinking for climate change (Saja Sanneh, 2018) Both the rich picture activity and mind mapping activity try to get across the idea that "everything is connected to everything else" and of the importance of seeing climate change and any other topic of study as consisting of patterns of change and interdependence rather than static, standalone facts (Senge, 1990)
4	What can we do at school? 45mins	Facilitator led initially		1. Come together into a big group and explain that it was easy to consider solutions for all of the different stakeholders but that now it's time to consider what the school can do 2. Distribute the Trocaire climate change handout for schools. Ask students to complete the checklist to see where their school rates. 3. Ask the students to create a mind map of actions that the school can take in order to help resolve climate change. Give them the energy	To explore actions students can take as a group	The mind maps are taken from this website. Permission has been granted from the creator to use the mind maps. Mind maps have traditionally been taught to students as an information retrieval technique (Ritchie, Della Salla, & McIntosh, 2013). While mind mapping has been shown to be effective in

				saving mind map and explain that this can be one branch of the 4. Write down the buzzwords that are common to all of the mind maps. These should include broad themes such as: - Transport - Recycling - Education - Vegan days - Awareness raising activities - Activities for new first years - Highlight possible activities that they can do. Ask them to create a survey consisting of five questions that they can ask other students in the school in order to understand what actions students in the school can take		improving information recall (Farrand, Hussain, & Hennessy, 2002) there is also some evidence suggesting it can improve understanding of material through the use of a deeper level of processing (Lockhart & Craik, 1990), thus improving the associations between different ideas that make up a concept for the creator.
5				End with two questions: what do we expect the planet to do for us? What do we expect we can do for the planet?	To consider the plant as more than a supplier of our needs but as something that needs to be protected	

Module 4: Coping with climate change – adaptation measures, health, renewables. Our future world						
#	Name and duration	Type	Resources Needed	Description	Aim	References
1	True or False 10 minutes	Facilitator led group activity	Handouts with 10 true or false questions on them Green and Red Marker	Break class into groups Distribute Handouts Ask the class to highlight the true statements in green and the false ones in red Write up as many statements as there are groups on the board Ask an individual from each group to come to the board and put a red or green circle around the statements: • Most people with exceptionally high IQ's are well adjusted in other areas of their life • In romantic relationships, opposites usually attract • Overall, married adults are happier than adults who are not married • In general, we only use about 10 percent of our brain • A person who is innocent of a crime has nothing to fear from a lie detector test • On some types of mental tasks, people perform better when they are 70 years old than when they are 20 years old • Usually, it is safe to awaken someone who is sleepwalking	As a warm up exercises; as a lead in to the next exercise explaining paradigm shifts Students understand that it is possible for many people to hold a wrong belief and that it is difficult to change people's minds	Popular videos on YouTube about cognitive dissonance, confirmation bias as well as an article outlining a list of different biases that cause humans to look for short cuts when considering certain types of problems
2	Explaining the idea of a paradigm and a	Group activity	Two sets of handouts (dates and	1. Students are asked to state any beliefs that they know people in the past held but which people nowadays know to be false. The example of the earth being flat is always a good one to begin with.	To highlight how current outdated beliefs might	While Kuhn's idea of a paradigm shift (Kuhn, The structure of scientific revolutions, 1962) is generally used to highlight

	paradigm shift 30mins		paradigm shifts)	Ask them why people believed in the idea of a flat world and whether they know why people started to believe that the world might actually be round. 2. Give the students the list of funny beliefs and ask them to put them on a timeline from the earliest to the latest, in terms of when people stopped believing in them. 3. After you have gone through the list ask students what they think about the last belief, that people on earth belief that the Earth's resources are infinite and that we can consume as much as we want to. Ask the groups to list five behaviours that occur as a result of this belief. 4. Link our overuse of resources with consumerism and then link consumerism with climate change using the carbon footprint calculator Ask each group to shout out different consumer behaviours and how they might affect climate change. Follow up on their answers with this worksheet	continue to influence our behaviour	fundamental changes in concepts or theories within scientific practice, he also talked about the complex social processes behind the values that make up dominant paradigm (Kuhn, The structure of scientific revolutions, 1962, p. 28). This has given rise to the use of the concept of the paradigm shift to describe a period of profound change in any cultural worldview, belief or perception of a system or event. This exercise aims to highlight the need for a change or the ongoing change away from materialistic viewpoint of the earth and towards a biospheric viewpoint (Balunde, Perlaviciute, & Truskauskaite-Kuneviciene, Sustainability in Youth: Environmental Considerations in Adolescence and Their Relationship to Pro-environmental Behavior, 2020)
3	30mins	Group activity and individual	Computers or else handouts Pens	1. Ask the students to consider their own carbon footprint using the Carbon footprint exercise. If there are computers available to students use the UN's carbon calculator 2. Following this, ask the groups to fill in the ecological handprint as a group, using one colour for what they are currently doing and another colour for what they think they and their families should be able to do	To understand the extent to which a belief can be damaging (in this case to the earth)	A carbon footprint is a tool used to highlight the extent to which a person's lifestyle is connected to greenhouse gas emissions. Generally, the carbon foot printing calculator includes all elements of a supply chain, from the production of raw materials

				3. Finally ask them each as a group to rate how difficult it might be to implement the changes that they have just considered.		through to consumption and on into disposal (SSGA, 2020). The calculator is also a useful way to highlight to students the processes behind their consumption patterns (Hertwich, Life cycle approaches to sustainable consumption: A critical review, 2005).
4	The move to sustainability 30 mins	Group activity	Glue Markers Scissors A3 sheets	1. Explain to the class that we are going back to the idea of a world of infinite resources. Ask each group to name again in turn where this belief has led our societies to. 2. Now ask the class to shout out what sort of a world they would like to be living in based on the ecological model. 3. Ask each group to identify the different ways through which they and their families can combat climate change. The 16 ways can be found here with explanations of the impact and effort needed for each activity here. 4. Give each group an A3 page and ask them to rate these activities from the easiest activity to do to the hardest. Ask them to cut and paste the 16 activities in that order onto the A3 page. 5. Now give them the same sheet again but ask them arrange them in order of the effort it will take 6. Ask them that if the way that we all live in the world at the moment means an increase in temperature of 1 degree every 10 years what will the earth look like in 100 years? Now ask them that if we make these small changes and the climate doesn't change as much as it is predicted to what will the earth look like in 100 years? 7. Explain that one is the maintenance of a belief system while the other is a paradigm shift. Use	The effects of a new thought or belief	This is directly linked with research highlighting the individual different people can make in combatting climate change (Hertwich, Life cycle approaches to sustainable consumption: A critical review, 2005) (Tukker & Jansen, 2008). It is important to remember not to place the onus too much on the individual while conducting this activity however, rather you are looking at processes and systems of which the individual is just one part (Saja Sanneh, 2018) (Helm, 2011). This is important so as to prevent the allocation of blame of students feeling guilty that their particular, individual, lifestyle is the cause of climate change

				previous shift such as corporal punishment to explain it		
5	Is sustainability local or global? 25 mins	Group activity		1: Quiz about climate change in Ireland and the world 2: Look at interactive slide explaining EU emissions: https://www.wri.org/insights/interactive-chart-shows-changes-worlds-top-10-emitters 3: Brainstorm in different groups why either China, USA or India produce more greenhouse gases 4:: Ask groups to brainstorm if this means that Chinese, American or Indian people are more responsible for climate change than Irish people 5: Explain that per person, Irish people contribute 50% more greenhouse emissions than the EU average. We have the third highest emission per person also in EU		

References

Nongqayi, L., Risenga, I., & Dukhan, S. (2022). Youth's knowledge and awareness of human contribution to climate change: the influence of social and cultural contexts within a developing country. *Educational and Development Psychologist, 39*, 44-57. Retrieved from 10.1080/20590776.2022.2050461

Agirreazkuenaga, L., & Martinez, P. (2021). Secondary school student's perception, positioning and insight on education for sustainabilitity. *International research in geographical andenvironmental education, 30*, 218-237. Retrieved from https://doi.org/10.1080/10382046.2021.1877952

Ajzen, I. (1991). The theory of planned behaviour. *Organizational Behavior and Human Decision Process, 50*(2), 179-211. doi:https://doi.org/10.1016/0749-5978(91)90020-T

Alexander, R., & Poyyamoli, G. (2017). Climate change education for school students-activity-based teaching learning approach to create knowledge, attitudes skills and behavioural change. *International Journal of Global Warming, 12*(3-4), 431-447. doi:10.1504/IJGW.2017.10005894

Ali Khan, N., Karpudewan, M., & Annamalai, N. (2021). Moving beyond the one size fits all model in describing the climate conserving behaviors of Malaysian scondary students. *Sustainability, 13*(18), 1-20. Retrieved from https://dx.doi.org/10.3390/su13010018

ALLEA. (2020). *A snapshot of climate change education initiatives in Europe: Some initial findings and implications for future climate change education research.* Berlin: ALLEA. doi:10.26356/climateeducation

An Taisce. (2016). *Green-schools programme.* Dublin: An Taisce Environmental Education Unit. Retrieved October 5, 2022, from https://greenschoolsireland.org/wp-content/uploads/2016/09/General-Handbook.pdf

Anderson, A. (2012). Climate Change Education for Mitigation and Adaptation. *Journal of Education for Sustainable Development, 6*(2), 191-206. doi:10.1177/0973408212475199

Anderson, A. (2013). Climate change education for mitigation and adaptation. *Journal of Education for Sustainable Development, 6*(2), 191-206. doi:10.1177/0973408212475199

APA. (2017). *Mental health and our changing climate.* Washington DC: American Psychological Association.

Appelbaum, N., Santen, S., Vota, S., Wingfield, L., Sabo, R., & Yaghmour, N. (2019). Threats to reliability and validity withr esident welness surveying efforts. *Journal of Graduate Medical Education, 11*(5), 543-549. doi:10.4300/JGME-D-19-00216.1

Ardoin, N., Bowers, A., Roth, N., & Holthuis, N. (2018). Environmental education and K-12 outcomes: A review and analysis of research. *The Journal of Environmnetal Education, 49*(1), 1-17. doi:https://doi.org/10.1080/00958964.2017.1366155

Armson, R. (2011). Drawing Rich Pictures. In R. Armson, *Growing wings on the way: Systems thinking for messy situations* (pp. 57-77). Axminster: Triarchypress.

Arya, D., & Maul, A. (2016). The building of knowledge, language, and decision-making about climate change science: a cross-national program for secondary students. *International Journal of Science Education, 38*(6), 885-904. doi:10.1080/09500693.2016.1170227

Axelrod, L., & Lehman, D. (1993). Responding to environmental concern: What factors guide individual action? *Journal of Environmental Psychology, 13*(2), 149-159. doi:10.1016/S0272-4944(05)80147-1

Azjen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behaviour.* Englewood Cliffs: Prentice-Hall.

Baierl, T. M., Kaiser, F. G., & Bogner, F. X. (2022). The supportive role of environmental attitude for learning about enviornmental issues. *Journal of Environmental Psychology, 81*, 1-11. doi:10.1016/j.jenvp.2022.101799

Balgopal, M., Klein, J., Brown, C., Sample McMeeking, L., Morgan, J., & Marshall Frasier, w. (2014). Linking biophysical, socioeconomic, and political effects of climate change on agro-ecosystems. *Journal of Geoscience Education, 62*(3), 343-353. Retrieved from https://www.proquest.com/docview/1564036917/fulltextPDF/F21593ECCDD8470FPQ/1?accountid=55804

Balunde, A., Perlaviciute, G., & Steg, L. (2019). The relationship between people's environmental considerations and pro-environmental behavior in Lithuania. *Frontiers in Psychology, 10*. doi:10.3389/fpsyg.2019.02319

Balunde, A., Perlaviciute, G., & Truskauskaite-Kuneviciene, I. (2020). Sustainability in Youth: Environmental Considerations in Adolescence and Their Relationship to Pro-environmental Behavior. *Frontiers in Psychology*. Retrieved from https://doi.org/10.3389/fpsyg.2020.582920

Bamberg, S., & Moser, G. (2007). Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmnetal behaviour. *Journal of Environmental Psychology, 27*(1), 14-25. doi:10.1016/j.jenvp.2006.12.002

Barker, C., Pistrang, N., & Elliott, R. (2002). *Research methods in clinical psychology: An introduction for students and practitioners* (2nd ed.). Chicester: John Wiley & Sons.

Barry, A. (2005). How attrition impacts the internal and external validity of longitudinal research. *Journal of School Health, 75*(7), 267-270. doi:10.1111/j.1746-1561.2005.00035.x

Barton, H., & Grant, M. (2006). A health map for the local human habitat. *The Journal of the Royal Society for the Promotion of Health, 126*(6), 252-261. doi:doi.org/10.1177%2F1466424006070466

Berglund, T., Gericke, N., & Change-Rundgren, S. (2014). The implementation of education for sustainable development in Sweden: investigating the sustainability consciousness among upper secondary students. *Research in Science and Technological Education, 32*(3), 318-339. doi:10.1080/02635143.2014.944493

Bergman, B. G. (2016). Assessing impacts of locally designed environmental education projects on students' environmental attitudes, awareness, and intention to act. *Environmental Education Research, 22*(4), 480-503. doi:https://doi.org/10.1080/13504622.2014.999225

Bernstein, J., & Szuster, B. (2019). The new environmental paradigm scale: Reassessing the operationalization of contemporary environmentalism. *The Journal of Environmental Education, 50*(2), 73-83. doi:10.1080/00958964.2018.1512946

Bodzin, A., & Qiong, F. (2014). The effectiveness of the geospatial curriculum approach on urban middle level students' climate change understandings. *Journal of Science Education & Technology, 23*(4), 575-590. doi:10.1007/s10956-013-9478-0

Boeve-de Pauw, J., Donche, V., & Van Petegem, P. (2011). Adolescents' environmental worldview and personality: An explorative study. *Journal of Environmental Psychology, 31*, 109-117. doi:10.1016/j.jenvp.2010.05.003

Bofferding, L., & Kloser, M. (2015). Middle and high school students conceptions of climate change mitigation and adaption strategies. *Environmental Education Research, 21*(2), 275-294. doi:http://dx.doi.org/10.1080/13504622.2014.888401

Bofferding, L., & Kloser, M. (2015). Middle and high school students' conceptions of climate change mitigation and adaptation strategies. *Environmental Education Research, 21*(2), 275-294. doi:10.1080/13504622.2014.888401

Bogner, F., & Wiseman, M. (2006). Adolescent's attitudes towards nature and environment. *Environmentalist, 26*, 231-237. doi:https://doi.org/10.1007/s10669-006-8660-9

Boland, L. (2022, January 29). *'Dismal' and 'inadequate' climate education must be tackled, students and teachers say.* Retrieved from thejournal.ie: https://www.thejournal.ie/climate-education-strategy-schools-5667296-Jan2022/

Bouman, T., Steg, L., & Kiers, H. (2018). Measuring Values in Environmental Research: A Test of an Environmental Portrait Value Questionnaire. *Personality and Social Psychology, 9*, 1-15. doi:https://doi.org/10.3389/fpsyg.2018.00564

Bourdieu, P. (1977). *Outline of a theory of practice.* Cambridge: Cambridge University Press.

Boyes, E., & Stanisstreet, M. (2011). Environmental education for behaviour change: Which actions should be targeted? *International Journal of Science Education, 34*(12), 1591-1614. doi:10.1080/09500693.2011.584079

Boyes, E., Skamp, K., & Stanisstreet, M. (2009). Australian secondary students' views about global warming: beliefs about actions, and willingness to act. *Research in Science Education, 39*, 661-680. doi:https://doi.org/10.1007/s11165-008-9098-5

Boys, A., Marsden, J., Stillwell, G., Hatchings, K., Griffiths, P., & Farrell, M. (2003). Minimising respondent attrition in longitudinal research: practical implications from a cohort study of adolescent drinking. *Journal of Adolescence, 26*(3), 363-373. doi:10.1016/s0140-1971(03)00011-3

Bracken, S. (2010). Discussing the importance of ontology and epistemology awareness in practitioner research. *Worcester Journal of Learning and Teaching, 4*, 1-9. Retrieved from https://eprints.worc.ac.uk/843/1/FinalSBrackenPractitionerResearch.pdf

Bratman, G. N., Olvera-Alvarez, H., & Gross, J. J. (2021). The affective benefits of nature exposure. *Social and Personality Psychology Compass, 15*(8). doi:https://doi-org.libraryproxy.mic.ul.ie/10.1111/spc3.12630

Brumann, S., Ohl, U., & Schulz, J. (2022). Inquiry-based Learning on climate change in upper secondary education: A design based approach. *Sustainability, 14*, 1-29. doi:10.3390/su14063544

Burgland, T., Gericke, N., & Chang-Rundgren, S. (2014). The implementation of education for sustainable development in Sweden: investigating the sustainability consciousness among upper secondary students. *Research in Science & Technological Education, 32*(3), 318-339. doi:https://doi-org.libraryproxy.mic.ul.ie/10.1080/02635143.2014.944493

Carr, A. (2016). *The handbook of clinical and adolescent psychology: A contextual approach* (3rd ed.). London: Routledge.

Cebrian, G., Pascual, D., & Moraleda, A. (2019). Perception of sustainability competencies amongst Spanish pre-service secondary school teachers. *International Journal of Sustainability in Higher Education, 20*(7), 1171-1190. doi:http://dx.doi.org/10.1108/IJSHE-10-2018-0168

Checkland, P., & Poulter, J. (2006). *Learning for Action: A short definitive account of soft systems methodology and its use for practitioners, teachers and students.* Chichester: John Wiley and Sons Ltd.

Chen, K. H. (2019). Transforming environmental values for a younger generation in Taiwan: A participatory Action Approach to Curriculum Design. *Journal of Future Studies, 23*(4), 79-96. doi:10.6531/JFS.201906_23(4).0008

Choy, E. (2014, August). *Body Earth Metaphor Workshop.* Retrieved from Movement Generation: https://movementgeneration.org/wp-content/uploads/2014/08/Body-Earth-Metaphor-2014.pdf

Clayton, S., Manning, C., Speiser, M., & Hill, A. (2021). *Mental health and out changing climate: impacts, inequities, responses* (2nd ed.). Washington DC: American Psychological Association and ecoAmerica. Retrieved from https://www.apa.org/news/press/releases/mental-health-climate-change.pdf

Cohen, J. (1992). A power primer. *Psychological Bulletin*, 1304-1312. doi:10.1037//0033-2909.112.1.155

Collado, S., Staats, H., & Corraliza, J. (2013). Experiencing nature in children's summer camps: Affective, cognitive and behavioral consequences. *Journal of Environmental Psychology, 33*, 37-44. Retrieved from https://doi.org/10.1016/j.jenvp.2012.08.002

Cordero, E., Centeno, D., & Todd, A. M. (2020). The role of climate change education on individual lifetime carbon emissions. *PloS ONE, 15*(2), 1-23. doi:10.1371/journal.pone.0206266

Corral-Verdugo, V. (1997). Dul 'realities of conservation behaviour: Self reports versus observations of re-use and recycling behaviour. *Journal of Environmental Psychology, 17*, 135-145. Retrieved from https://doi.org/10.1006/jevp.1997.0048

Costello, A., Abbas, M., Allen, A., Ball, S., Bell, S., Bellamy, R., . . . Patterson, C. (2009). Managing the health effects of climate change. *The Lancet Commissions, 373*(9676), 1693-1733. doi:https://doi.org/10.1016/S0140-6736(09)60935-1

Crocetti, E., Rubini, M., Luyckx, K., & Meeus, W. (2007). Identity formation in early and middle adolescents from various ethnic groups: From three dimensions to five statuses. *journal of Youth and Adolescence, 37*, 983-996. doi:10.1007/s10964-007-9222-2

Crotty, M. (1998). *The foundations of social research: meaning and perspective in the research process.* London: Sage.

CSO. (2021). *Environmental Indicators in Ireland.* Retrieved from Central Statistics Office : https://www.cso.ie/en/releasesandpublications/ep/p-eii/environmentalindicatorsireland2021/mainfindings/

Damerell, P., Howe, C., & Milner-Gulland, E. J. (2013). Child-orientated environmental education influences adult knowledge and household behaviour. *Environmental Research, 8*(1), 1-8. Retrieved from 10.1088/1748-9326/8/1/015016

Davis, A., & Stroink, M. (2015). The relationship between systemes thinking and the New Ecological Paradigm. *Systems Research and Behavioural Science, 33*(4), 575-586. Retrieved from https://doi-org.libraryproxy.mic.ul.ie/10.1002/sres.2371

Dawson, V. (2015). Western Australian high school students' understandings about the socioscientific issue of climate change. *International Journal of Science Education, 37*, 1024-1043. doi:https://doi-org.libraryproxy.mic.ul.ie/10.1080/09500693.2015.1015181

de Groot, J., & Steg, L. (2007). Value orientations to explain beliefs related to environmnetal significant behaviour: how to measure egoistic, alotruistic and biospheric value orientations. *Environmental Behaviour, 40*, 330-354. doi:10.1177/0013916506297831

deGroot, J., & Steg, L. (2007). General beliefs and the theory of planned behaviour: The role of environmental concerns in the TPB. *Journal of Applied Social Psychology, 37*(8), 1817-1836.

Deisenrieder , V., Kubisch, S., Keller, L., & Stötter, J. (2020). Bridging the action gap by democratizing climate change education-The case of k.i.d.Z.21 in the context of Fridays for Future. *Sustainability , 12*, 1-19. doi:10.3390/su12051748

Deisenrieder, V., Kubisch, S., Keller, L., & Stötter, J. (2020). Bridging the action gap by democratizing climate change education-The case of k.i.d.Z.21 in the context of Fridays for Future. *Sustainability, 12*, 1-19. doi:10.3390/su12051748

Department of Education and Skills. (2016). *School self-evaluation guidelines 2016-2020.* Dublin: Department of Education and Skills. Retrieved from https://www.gov.ie/en/publication/5c47a7-school-self-evaluation-guidelines/

Department of the Environment, Climate and Communications. (2021, July). *Government approves landmark Climate Bill putting Ireland on the path to net-zero emissions by 2050.* Retrieved from gov.ie: https://www.gov.ie/en/press-release/22e97-government-approves-landmark-climate-bill-putting-ireland-on-the-path-to-net-zero-emissions-by-2050/

Dept of Communications, Climate Action and Environment. (2019). *Climate Action Plan.* Dublin: Government of Ireland. Retrieved from https://assets.gov.ie/25419/c97cdecddf8c49ab976e773d4e11e515.pdf

Dept of Education. (2022). *Looking at Our School 2022: A quality framework for post-primary schools.* Dublin: Department of Education. Retrieved from https://www.gov.ie/en/publication/b1bb3-looking-at-our-school-2022/

Dept of Education and Skills. (2014). *Education for Sustainability : The National Strategy on Education for Sustainable Development in Ireland, 2014-2020.* Dublin: Dept of Education and Skills. Retrieved from http://www.unesco.org/education/edurights/media/docs/a0b5b82b0e14b72030246935ad6a1bf914f158bc.pdf

Dept of the Environment, Climate and Communications. (2021). *Climate Action Plan 2021: Securing our Future.* Dublin: Government of Ireland, Department of the Environment, Climate and Communications. Retrieved July 11th , 2022, from https://assets.gov.ie/224574/be2fecb2-2fb7-450e-9f5f-24204c9c9fbf.pdf

DES. (2014). *The national strategy on education for ssutainable development in Ireland, 2014-2020.* Dublin: Department of Education and Skills. Retrieved from file:///C:/Users/35387/Downloads/70926_7e8f9ccf9069441e960d7f32a38dc7b9.pdf

DES. (2015). *Framework for Junior Cycle.* Dublin: Ireland: Department of Education and Skills. Retrieved 18 10, 2022, from https://ncca.ie/media/3249/framework-for-junior-cycle-2015-en.pdf

Dhanapal, S., & Lim, C. (2013). A comparative study of the impacts and students' perceptions of indoor and outdoor learning in the science classroom. *Asia-Pacific Forum on Science Learning and Teaching, 14*(2), 1-23. Retrieved from http://libraryproxy.mic.ul.ie/login?url=https://www.proquest.com/scholarly-journals/comparative-study-impacts-students-perceptions/docview/1955901936/se-2.

Dietz, T., Gardner, G., Gilligan, J., Stern, P., & Vandenbergh, M. (2009). Household actions can provide a behavioral wedge to rapidly reduce US carbon emissions. *PNAS, 106*(44), 18452-18456. doi:https://doi.org/10.1073/pnas.0908738106

Dolan, A. (2022). *Teaching climate change in primary schools.* Dublin: Routledge.

Duerden, M., & Witt, P. (2010). The impact of direct and indirect experiences on the development of environmental knowledge, attitudes, and behavior. *Journal of Environmental Psychology, 30*(4), 379-392. doi: Mat D. Duerden; Peter A. Witt (2010). The impact of direct and indirect experiences on the develodoi:10.1016/j.jenvp.2010.03.007

Dunlap, R. (2008). The New Environmental Paradigm Scale: From marginality to worldwide use. *Journal of Environmental Education, 40*(1), 3-18. doi:10.3200/JOEE.40.1.3-18

Dunlap, R., Van Liere, K., Mertig, A., & Jones, R. (2000). Measuring endorsement of the new ecological paradigm: A revised NEP scale. *Journal of Social Issues, 56*(3), 425-442. doi: https://doi.org/10.1111/0022-4537.00176

Duvall, J., & Zint, M. (2007). A review of research on the effectiveness of environmnetal education in promoting intergenerational learning. *The Journal of Environmental Education, 38*(4), 14-24. doi:10.3200/JOEE.38.4.14-24

ECO UNESCO. (2010). *Youth for the Future: Creating a sustainable world.* Dublin: ECO UNESCO. Retrieved from https://issuu.com/ecounesco/docs/youth_for_the_future_resource

Eggert, S., Nitsch, A., Boone, W., Nuckles, M., & Bogeholz, S. (2017). Supporting students learning and socioscientific reasoning about climate chnage- the effect of computer-based concept mapping scaffolds. *Research in Science Education, 47*, 137-159. doi:10.1007/s11165-015-9493-7

Environmental Protection Agency. (2019). *Where are Ireland's emissions coming from?* Retrieved from EPA: https://www.epa.ie/media/epa-2020/monitoring-amp-assessment/climate-change/Ireland%C3%A2%C2%80%C2%99s_GHG_emissions_sources_and_solutions.pdf

EPA. (2022, June). *Greenhouse gas emissions and projections - Key messages.* Retrieved from Environmental Protection Agency: https://www.epa.ie/our-services/monitoring--assessment/climate-change/ghg/key-messages/

EPA. (2022, June). *Latest Emissions Data.* Retrieved from Environmental Protection Agency: https://www.epa.ie/our-services/monitoring--assessment/climate-change/ghg/latest-emissions-data/

Farrand, P., Hussain, F., & Hennessy, E. (2002). The efficacy of the 'mind map' study technique. *Medical Education, 36*, 426-431. doi:10.1046/j.1365-2923.2002.01205.x

Faul, F., Erdfelder, E., Buchner, A., & Lang, A. (2007). G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*(2), 175-191. doi:10.3758/bf03193146

Fehr-Duda, H., & Fehr, E. (2016). Sustainability: Game human nature. *Nature, 530*, 413-415. doi:https://doi.org/10.1038/530413a

Feinstein, N., & Mach, K. (2019). Three roles for education in climate change adaptation. *Climate Policy*, 1469-3062. doi:https://doi.org/10.1080/14693062.2019.1701975

Field, A. (2017). *Discovering Statistics using IBM SPSS statistics* (5th ed.). London: Sage.

Flora, J. A., Saphir, M., Lappé, M., Roser-Renouf, C., Maibach, E., & Leiserowitz, A. (2014). Evaluation of a national high school entertainment education program: The Alliance for Climate Education. *Climatic Change, 127*(3-4), 419-434. doi:10.1007/s10584-014-1274-1

Frankel, S., Sellmann-Risse, D., & Basten, M. (2019). Fourth graders' connectedness to nature - Does cultural background matter? *Journal opf Environmental Psychology, 66*, 1-7. doi:https://doi.org/10.1016/j.jenvp.2019.101347

Frick, J., Kaiser, F., & Wilson, M. (2004). Environmental knowledge and conservation behaviour: Exploring prevalence and structure in a representative sample. *Personality and Individual differences, 37*(8), 1597-1613. doi:http://dx.doi.org/10.1016/j.paid.2004.02.015

Fritze, J., Blashki, G., Burke, S., & Wiseman, J. (2008). Hope, despair and transformation: Climate change and the promotion of mental health and wellbeing. *International journal of mental health systems, 2*, 1-13. doi:10.1186/1752-4458-2-13

Gallagher, K. (2008). *The Methodological Dilemma: Creative, critical, collaborative and post-positivist .* London: Rutledge.

Gatersleben, B., Murtagh, N., & Abrahamse, W. (2014). Values, identity and pro-environmental behaviour. *Contemporary Social Science, 9*, 374-392. doi:10.1080/21582041.2012.682086

Goeschl, T., & Perino, G. (2012). instrument choice and motivation: Evidence from a climate change experiment. *Environmental Resources Economics, 52*, 195-212. doi:10.1007/s10640-011-9524-4

Gottlieb, D., Vigoda-Gadot, E., & Haim, A. (2013). Encouraging ecological behaviors among students by using the ecological footprint as an educational tool: a quasi-experimental design in a public high school in the city of Haifa. *Environmental Education Research, 19*(6), 844-863. doi:10.1080/13504622.2013.768602

Gottlieb, D., Vigoda-Gadot, E., & Haim, A. (2013). Encouraging ecological behaviors among students by using the ecological footprint as an educational tool: a quasi-experimental design in a public high school in the city of Haifa. *Environmental Education Research, 19*(6), 844-863. doi:10.1080/13504622.2013.768602

Gottlieb, D., Vigoda-Gadot, E., Haim, A., ., ,, & . (2013). Encouraging ecological behaviors among students by using the ecological footprint as an educational tool: a quasi-experimental design in a public high school in the city of Haifa. *Environmental Education Research, 19*(6), 844-863. doi:10.1080/13504622.2013.768602

Gough, D. (2007). Weight of Evidence: A framework for the appraisal of the quality and relvence of evidence. *Research Papers in Education, 22*(2), 213-228. doi:10.1080/02671520701296189

Government of Ireland. (2018). *Data Protection Act, 2018.* Retrieved from https://www.gov.ie/pdf/?file=https://assets.gov.ie/122558/49907c6f-a2e5-4c9e-8ee0-953315da668c.pdf#page=null

Government of Ireland. (2022). *2nd national strategy on education for sustainable development ESD to 2030.* Dublin: Govt of Ireland. Retrieved 10 13, 2022, from https://www.gov.ie/en/publication/02952d-national-strategy-on-education-for-sustainable-development-in-irelan/

Government of Ireland. (2022). *ESD to 2030: Implementation plan 2022-2026.* Dublin: Government of Ireland. Retrieved from https://www.gov.ie/en/publication/02952d-national-strategy-on-education-for-sustainable-development-in-irelan/

Gowdy, J. (2008). Behavioral economics and climate change policy. *Journal of Economic behavior and organisation, 68*(3-4), 632-644. doi:10.1016/j.jebo.2008.06.011

Griffin, P., Heede, R., & van Der Vlugt, I. (2017). *The Carbon Majors database.* Brussels: Carbon Disclosure Project. Retrieved from Sustainability for all: https://cdn.cdp.net/cdp-production/cms/reports/documents/000/002/327/original/Carbon-Majors-Report-2017.pdf?1501833772

Grønhøj, A., & Thøgersen, J. (2009). Like father, like son? Intergenerational transmission of values, attitudes, and behaviours in the environmental domain. *Journal of Environmental Psychology, 29*(4), 414-421. doi:10.1016/j.jenvp.2009.05.002

Grønhøj, A., & Thøgersen, J. (2012). Action speaks louder than words: The effect of personal attitudes and family norms on adolescents' pro-environmental behaviour. *Journal of Economic Psychology, 33*(1), 292-302. doi:10.1016/j.joep.2011.10.001

Hall, T., & Murray, B. (2010). *Universal Design for Learning.* Washington: TEAL. Retrieved from https://lincs.ed.gov/sites/default/files/2_TEAL_UDL.pdf

Han, H., Hsu, J., & Chwen, S. (2010). Application of the theory of planned behaviour to green hotel choice: Testing the effect of environmentally friendly activities. *Tourism Management, 31*(3), 325-334. doi:https://doi.org/10.1016/j.tourman.2009.03.013

Heberlein, T. (2012). *Navigating environmental attitudes.* New York: Oxford University Press.

Helm, D. (2011). Sustainable consumption, climate change and future generations. *Royal Institute of Philosophy, 69*, 235-252. doi: https://doi.org/10.1017/S1358246111000294

Hermans, M., & Korhonen, J. (2007). Ninth graders and climate change: Attitudes towards consequences, views on mitigation, and predictors of willingness to act. *International Research in Geographical and Environmental Education, 26*(3), 223-239. doi:https://doi.org/10.1080/10382046.2017.1330035

Hermans, M., & Korhonen, J. (n.d.). Ninth graders and climate change: Attitudes towards consequences, views on mitigation, and predictors of willingness to act. *NTERNATIONAL RESEARCH IN GEOGRAPHICAL AND ENVIRONMENTAL EDUCATION, 26*(3), 223-239. doi:https://doi.org/10.1080/10382046.2017.1330035

Hertwich, E. (2005). Life cycle approaches to sustainable consumption: A critical review. *Environmental science and technology, 39*(13), 4673-4684. doi:https://doi.org/10.1021/es0497375

Hertwich, E., & Peters, G. (2009). Carbon footprint of nations: A global, trade-linked analysis. *Environmental Science and Technology, 43*(16), 6414-6420. doi:https://doi.org/10.1021/es803496a

Hesse-Biber, C. (2019). The role of hybrid methodologies in understanding complex environmental issues and promoting social justice. *International Journal for Transformative Research, 6*(1), 20-26. doi:https://doi.org/10.1515/ijtr-2019-0004

Hicks, D. (2019). Education and Climate Change. In C. Simon, & S. Ward, *A student's guide to education studies.* London: Routledge.

Hines, J. (1987). Analysis and synthesis of research on responsible environmental behaviour: A meta-analysis. *Journal of Environmental Education, 18*(2), 1-8.

Hines, J., Hungerford, H., & Tomera, A. (1987). Analysis and synthesis of research on responsible environmental behaviour: A meta-analysis. *The Journal of Environmental Education, 18*(2), 1-8. doi:10.1080/00958964.1987.9943482

Hormio, S. (2017). Can corporations have (moral) responsibility regarding climate change mitigation. *Ethics, Policy and Environment, 20*(3), 314-332. doi:10.1080/21550085.2017.1374015

Howard-Jones, P., Sands, D., Dillon, J., & Fenton-Jones, F. (2021). The views of teachers in England on an action-oriented climate change curriculum. *Environmental Education Research, 27*(11), 1660-1680. doi:https://doi-org.libraryproxy.mic.ul.ie/10.1080/13504622.2021.1937576

Hu, S., & Chen, J. (2016). Place-based inter-generational communication on local climate improves adolescents' perceptions and willingness to mitigate climate change. *Climatic Change, 138*, 425-438. doi:10.1007/s10584-016-1746-6

Hungerford , H., & Volk, T. (1990). Changing learner behaviour through environmental education. *The Journal of Environmental Education, 21*, 8-21. doi:10.1080/00958964.1990.10753743

Hungerford, H. R. (1996). The development of responsible environmental citizenship: A critical challenge. *Journal of Interpretation Research, 1*(1), 25-37. doi: Hungerford, Harold R. (1996). The Development of Responsible Environmental Citizenship: 10.1177/109258729600100104

Hyman, E. (2020, January 2). *Who's really responsible for climate change?* Retrieved from Harvard Political Review: https://harvardpolitics.com/climate-change-responsibility/

Ignell, C., Davies, P., & Lundholm, C. (2019). A longitudinal study ofupper secondary school students' values and beliefs regarding policy responses to climate change,. *Environmental Education Research, 25*(6), 614-632. doi:https://doi.org/10.1080/13504622.2018.1523369

Ihlen, O. (2009). Business and climate change: The climate response of the world's 30 largest coroprations. *3*(2), 242-262. doi:10.1080/17524030902916632

IPCC. (2014). Summary for Policymakers. In IPCC, *Climate Change 2014: Mitigation of Climate Change.* Cambridge: Cambridge University Press. Retrieved from https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_summary-for-policymakers.pdf

IPCC. (2014). Summary for Policymakers. In IPCC, *Climate Change 2014: Impacts, adaptation and vulnerability.* Cambridge: Cambridge University Press. Retrieved from https://drive.google.com/file/d/1Auac2VSmsQ9DxVVs5oce-oq4-2zRP5jw/view?usp=sharing

IPCC. (2021). Climate Change 2021: Summary for Policymakers. In V. Masson-Delmotte, A. Zhai, S. Pirani, C. Connors, S. Péan, N. Berger, . . . B. Shou, *Climate Change 2021: The Physical Science Basis.* Cambridge: Cambridge University Press.

IPCC. (2022). IPCC 2022: Summary for policy makers. In D. R. H.-O. Pörtner, *Climate Change 2022: impacts, adaptation and vulnerability. Contribution of Working Group III to the Sixth Assessment Report of the intergovernmental panel on Climate Change* (pp. 3-33). Cambridge, UK: Cambridge University Press. doi:10.1017/9781009325844.001

IPCC. (2022). Summary for Policymakers. In J. S. P.R. Shukla, *Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (pp. 1-48). Cambridge UK: Cambridge University Press. doi:10.1017/9781009157926.001

IPCC. (2022). *Working Group III contribution to the sixth assesment repoert of the intergovernmenal panel on climate change.* Geneva: UNEP/IPCC. Retrieved July 11, 2022, from https://report.ipcc.ch/ar6wg3/pdf/IPCC_AR6_WGIII_FinalDraft_FullReport.pdf

Ismail, K. M., Ayub, A. F., & Subramanian, R. (2021). Effect of environmental education modul towards pupils knowledge and behaviour intention among primary pupils. *International Journal of Academic Research in Business and Social Sciences, 11*(7), 402-407. doi:10.6007/IJARBSS/v11-i7/9241

Jackson, L., & Pang, M. F. (2017). Secondary school students' views of climate change. *International research in geographical and environmental education*, 1-13. doi:10.1080/10382046.2017.1330036

Jackson, T. (2005). *Motivating sustainable consumption. A review of evidence on consumer behaviour and behavioural change.* Surrey: Centre for Environmental Strategy. Retrieved from http://www.sd-research.org.uk/wp-content/uploads/motivatingscfinal_000.pdf

Jennings, F. (2019). Where to turn? The influence of infomration source on belief and behavior. *Journal of Risk Research, 22*(2), 909-918. doi:10.1080/13669877.2017.1422788

Jensen, B. B. (2002). Knowledge, action and pro-environmental behaviour. *Environmental Education Research, 8*(3), 325-334. doi:http://dx.doi.org/10.1080/13504620220145474

Jensen, B. B., Schnack, K., & Simovska, V. (2000). *Critical environmental and health education: research issues and challenges.* Copenhagen: The Danish University of Education.

Jia, F., & Yu, H. (2021). Action, communication, and engagement: how parents "ACE" Children's pro-environmental behaviors. *Journal of Environmental Psychology, 74*, 1-9. doi:10.1016/j.jenvp.2021.101575

Jie Li, C., & Monroe, M. (2017). Exploring the essential psychological factors in fostering hope concerning climate change. *Environmnental Education Research, 25*, 936-954. doi:10.1080/13504622.2017.1367916

Johnson, B., & Činčera, J. (2021). Relationships between outdoor environmental education program characteristics and children's environmental values and behaviors. *Journal of Adventure Education and Outdoor Learning*, 1-19. Retrieved from 10.1080/14729679.2021.2001756

Jorgenson, S., Stephens, J., & White, B. (2019). Environmental education in transition: A critical review of recent research on climate change and energy education. *The Journal of Environmental Education, 50*(3), 160-171. doi:10.1080/00958964.2019.1604478

Jurek, M., Frajer, J., Fiedor, D., Brhelova, J., Hercik, J., & Jáč, M. (2022). Knowledge of global climate change among Czech students and its influence on their beliefs in the efficacy of mitigation action. *Environmental Education Research*, 1-19. Retrieved from https://doi.org/10.1080/13504622.2022.2086687

Kahlor, L. (2007). An augmented risk information seeking model: the case of global warming. *Media Psychology, 10*(3), 414-435. doi:10.1080/15213260701532971

Kaiser, F. (1998). A general measure of ecological behaviour. *Journal of Applied Social Psychology, 28*(5), 395-422. Retrieved from https://doi.org/10.1111/j.1559-1816.1998.tb01712.x

Kaiser, F. (2007). Behaviour-based environmental attitude: Develoipment of an instrument for adolescents. *Journal of Environmental Psychology, 28*, 242-251. doi:10.1016/j.jenvp.2007.06.004

Kaiser, F., Roczen, N., & Bogner, F. X. (2008). Competence formation in environmental education: advancing ecology-specific rather than general abilities. *Umweltpsychologie, 12*(2), 56-70. Retrieved from https://doi.org/10.5167/uzh-9249

Kaniušonytė, G. (2019). *Identity and pro-environmental behaviour in adolescence and emerging adulthood: Findings from intervention piloting study.* Villnius: Environmental Psychology Research Centre. Retrieved from https://www.researchgate.net/publication/336135475_Identity_and_Pro-Environmental_Behavior_in_Adolescence_and_Emerging_Adulthood_Findings_From_Intervention_Piloting_Study

Kaplan, A., & Garner, J. (2017). A complex dynamic systems perspective on identity and its development: The dynamic systems model of role identity. *Developmental Psychology, 53*, 2036-2051. doi:10.1037/dev0000339

Karpudewan, M., & Mohd Ali Kahn, N. S. (2017). Experiential-based climate change education: fostering students' knowledge and motivation towards the environment. *INTERNATIONAL RESEARCH IN GEOGRAPHICAL AND ENVIRONMENTAL EDUCATION, 26*(3), 207-222. doi:https://doi.org/10.1080/10382046.2017.1330037

Kellstedt, P. M. (2008). Personal Efficacy, the information environment, and attitudes towards global warming and climate change in the United States. *Risk Analysis, 28*(1), 113-127. doi:10.1111/j.1539-6924.2008.01010.x

Kelly, G. (1991). *The psychology of personal construct .* London: Routledge.

Khadka, A., Lie, C. J., Stanis, S. W., & Morgan, M. (2021). Unpacking the power of place-based education in climate change communication. *Applied environmental education and communication, 20*(1), 77-91. doi:10.1080/1533015X.2020.1719238

Kirwan, P. (2021, March). *What we do*. Retrieved from Iirsh Schools Sustainability Network: https://www.issn.ie/what-we-do

Klockner, C. (2013). A comprehensive model of the psychology of environmental behavior - A meta analysis. *Global Environmental Change, 23*, 1028-1038. doi:http://dx.doi.org/10.1016/j.gloenvcha.2013.05.014

Klockner, C., & Blobaum, A. (2010). A comprehensive action determination model: Towards a broader understanding of ecological behaviour using the example of travel mode choice. *Journal of Environmental Psychology, 30*(4), 574-586. doi:https://doi.org/10.1016/j.jenvp.2010.03.001

Klockner, C., Matthies, E., & Hunecke, M. (2006). Problems of Operationalizing Habits and Integrating Habits in Normative Decision-Making Models. *Journal of Applied Social Psychology, 33*(2), 396-417. doi:https://doi.org/10.1111/j.1559-1816.2003.tb01902.x

Kollmuss, A., & Agyeman, J. (2002). Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behaviour? *Environmental Education Research, 8*(3), 239-260. doi:http://dx.doi.org/10.1080/13504620220145401

Kovács, J., Medvés , D., & Pántya, J. (2020). The relationship between environmental knowledge of preteens and their choice among plastic and non-plastic materials for a manual task. *Environmental Education Research, 26*(6), 849-863. doi:https://doi.org/10.1080/13504622.2020.1752363

Krettenauer, T. (2017). Pro-environmental behaviour and adolescent moral development. *Research on Adolescence, 27*(3), 581-593. doi:https://onlinelibrary.wiley.com/doi/10.1111/jora.12300

Kuhn, T. (1962). *The structure of scientific revolutions.* Chicago: University of Chicago Press.

Kuhn, T. (1996). *The structure of scientific revolutions* (3rd ed.). Chicago: University of Chicago Press.

Kuipers, K., & Hysom, S. (2014). Common problems and solutions in experiements. In M. Webster, & J. Sell, *Laboratory Experiments in the Social Sciences* (2nd ed., pp. 145-177). Academic Press. doi:10.1016/B978-0-12-404681-8.00007-8

Laerd Statistics. (2022). *Sphericity - Statistical Guides*. Retrieved January 27, 2023, from Laerd Statistics: https://statistics.laerd.com/statistical-guides/sphericity-statistical-guide.php

Lang, J. (2022). *IPCC Explainer: Stopping Climate Change.* Retrieved from Energy and Climate Intelligence Unit: https://ca1-eci.edcdn.com/infographics/IPCC_WGIII_Options_15_Aug_22.pdf?v=1664285366

Law, M., Stewart, D., Pollock, N., Letts, L., Bosch, J., & Westmoreland, M. (1998). *Critical Review Form for Quantitative Studies.* Hamilton: McMaster University. Retrieved from https://unisa.edu.au/siteassets/episerver-6-files/global/health/sansom/documents/icahe/cats/mcmasters_quantitative-review.pdf

Law, M., Stewart, D., Pollock, N., Letts, L., Bosch, J., & Westmorland, M. (1998). *Guidelines for critical review form - Quantitative studies.* Hamilton: McMaster University. Retrieved from https://unisa.edu.au/siteassets/episerver-6-files/global/health/sansom/documents/icahe/cats/mcmasters_quantitative-review.pdf

Lehnert, M., Fiedor, D., Frajer, J., Hercik, J., & Jurek, M. (2019). Czech students and mitigation of global warming: beliefs and willingness to take action. *Environmental Education Research*, 1-26. doi:10.1080/13504622.2019.1694140

Leigh, K. (2009). Energy Busters Norfol Schools Fight Climate Change. *Environmental Education*, 13-14.

Leiserowitz, A., Smith, N., & Marlon, J. (2011). *American teens' knowledge of climate change.* New Haven: Yale Project on climate change communication.

Lenton, T. M., Rockstrom, J., Gaffney, O., Rahmstorf, S., Richardson, K., Steffen, W., & Joachiim Schellnhuber, H. (2019). Climate tipping points - too risky to bet against. *Nature, 575*, 592-598. doi:https://media.nature.com/original/magazine-assets/d41586-019-03595-0/d41586-019-03595-0.pdf

Lester, B. T., Ma, L., Lee, O., & Lambert, J. (2006). Social activism in elementary science education: a science, technology, and society approach to teach global warming. *International Journal of Science Education, 28*(4), 315-339. doi:https://doi.org/10.1080/09500690500240100.

Li, C. J., Monroe, M., Oxarart, A., & Ritchie, T. (2021). Building teachers' self-efficacy in teaching about climate change through educative curriculum and professional development. *Applied Environmental Education and Communication, 20*(1), 34-48. doi:https://doi-org.libraryproxy.mic.ul.ie/10.1080/1533015X.2019.1617806

Lockhart, R., & Craik, F. (1990). Levels of processing: A retrospective commentary on a framework for memory research. *Canadian Journal of Experimental Psychology, 44*(1), 87-112. Retrieved from 10.1037/h0084237

Lunholm, C. (2019). Where to look and what to do? Blank and bright spots in research on environmental and climate chnage education. *Environmental Education Research, 25*(10), 1427-1437. doi:10.1080/13504622.2019.1700066

Maciejewski, M. (2020). Quasi-experimental design. *Biostatistics and Epidemiology, 4*(1), 38-47. doi:10.1080/24709360.2018.1477468

Malhi, Y., Franklin, J., Seddon, N., Solan, M., Turner, M., Field, C., & Knowlton, N. (2020). Climate change and eco-systems: threats, opportunities and solutions. *Philosophical transactions of the Royal Society B, 375*(1794). doi:https://doi.org/10.1098/rstb.2019.0104

Manoli, C., johnson, B., Hadjichambis, A., Hadjichambi, D., Georgiou, Y., & Ioannou, H. (2014). Evaluating the impact of the Earthkeepers Earth education program on children's ecological understandings, values and attitudes, and behaviour in Cyprus. *Studies in Education al Evaluation, 41*, 29-37. doi:http://dx.doi.org/10.1016/j.stueduc.2013.09.008

Martin, C., & Czellar, S. (2017). Where do biospheric values come from? A connectedness to nature perspective. *Journal of Environmental Psychology, 52*, 56-68. doi:https://doi.org/10.1016/j.jenvp.2017.04.009

Martinez Sainz, M., Mallon, B., & Oberman, R. (2019). *A Framework for Assessing the Impact of Climate Change Education in Schools.* European Educational Research Association. Retrieved from https://eera-ecer.de/ecer-programmes/conference/24/contribution/48605/

Mason, L., Ronconi, A., Scrimin, S., & Pazzaglia, F. (2021). Short-term exposure to nature and benefits for students' cognitive performance: a reviee . *Educational Psychology Review*, 1-39. doi:Short-Term Exposure to Nature and Benefits for Students' Cognitive Performance: a Review

Matthies, E., Selge, S., & Klockner, C. A. (2012). The role of parental behaviour for the development of behaviour specific environmental norms - The example of recycling and re-use behaviour. *journal of Environmental Psychology, 32*(3), 277-284. doi:10.1016/j.jenvp.2012.04.003

McDonald, J. (2008). Measuring personality constructs: The advantages and disadvantages of self-reports, informant reports and behavioural assessments. *Enquire, 1*(1), 75-94. Retrieved from https://www.nottingham.ac.uk/sociology/documents/enquire/volume-1-issue-1-dodorico-mcdonald.pdf

McIntyre, O. (2020, August). *The Irish Supreme Court Judgment in Climate Case Ireland: 'One Step Forward and Two Steps Back'.* Retrieved from IUCN: https://www.iucn.org/news/world-commission-environmental-law/202008/irish-supreme-court-judgment-climate-case-ireland-one-step-forward-and-two-steps-back

McNally, B. (2020). *Citizen's views of climate action in Ireland: Insights on media use, trusted sources and perceptions.* Wexford: Environmental Protection Agency. Retrieved from https://www.epa.ie/publications/research/climate-change/Research_Report_344.pdf

McNeal, P., Petcovic, H., & Reeves, P. (2017). What is motivating middle-school science teachers to teach climate change? *International Journal of Science Education, 39*(8), 1069-1088. doi:https://doi.org/10.1080/09500693.2017.1315466

Mead, E., Roser-Renouf, C., Rimal, R., Flora, J., Maibach, E., & Leiserowitz, A. (2012). Information seeking about global climate change among adolescents: The role of risk perceptions, efficacy beliefs and parental influences. *Atlantic Journal of Communications, 20*(1), 31-52. doi:10.1080/15456870.2012.637027

Meehan, C. R., Levy, B. L., & Collet-Gildard, L. (2018). Global climate change in U.S. high school curricula: Portrayals of the causes, consequences, and potential responses. *Science Education, 102*(3), 498-528. doi:https://doi-org.libraryproxy.mic.ul.ie/10.1002/sce.21338

Mellis, C. (2020). How to choose your study design. *Journal of Paediatrics and Child Health*, 1-5. doi:10.1111/jpc.14929

Michie, S., Johnston, M., Francis, J., Hardeman, W., & Eccles, M. (2008). From Theory to Intervention: Mapping Theoretically derived behavioural determinants to behavour change techniques. *Applied Psychology, 57*(4), 660-680. doi:10.1111/j.1464-0597.2008.00341.x

Millar, R. (2009). *Analysing practical activities to assess and improve effectiveness: The Practical Activity Analysis Inventory (PAAI).* York: Centre ofr Innovation and Research in Science Education.

Miller, N., Kumar, S., Pearce, K., & Baldock, K. (2021). The outcomes of nature-based learning for primary school aged children: a systematic review of quantitative research. *Environmental Education Research*, 1115-1140. doi:https://doi.org/10.1080/13504622.2021.1921117

Minitab Statistics. (2015, Sept). *Repeated Measures Designs: Benefits, Challenges, and an ANOVA Example.* Retrieved from Minitab: https://blog.minitab.com/en/adventures-in-statistics-2/repeated-measures-designs-benefits-challenges-and-an-anova-example

Minnock, K., Sullivan, J., & Dick, H. (2021). *Climate Action: Creating a Just and Sustainable World: Specification for Junior Cycle.* Dublin.

Mochizuki, Y., & Bryan, A. (2015). Climate change education in the context of education for sustainable development. *Journal of Education for Sustainable Development, 9*(1), 4-26. doi:10.1177/0973408215569109

Mochizuki, Y., & Bryan, A. (2015). Climate change education in the context of education for sustainable development: Rationale and principles. *Journal of Education for Sustainable Development, 9*(1), 4-26. doi:10.1177/0973408215569109

Mochizuki, Y., & Bryan, A. (2015). Climate change education in the context of education for sustainable development: Rationale and principles. *Journal of Education for Sustainable Development, 9*(1), 4-26. doi:10.1177/0973408215569109

Moellendorf, D. (2015). Climate Change Justice. *Philosophy Compass*, 173-186. doi:10.1111/phc3.12201

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLoS Med, 6*(7). doi:10.1371/journal.pmed1000097

Monroe, M., Plate, R., Oxarart, A., Bowers, A., & Chaves, W. (2017). Idenitfying effective climate change education strategies: a systematic review of the research. *Environmental Education Research*, 1-23. doi:https://doi.org/10.1080/13504622.2017.1360842

Monus, F. (2022). Environmental education policy of schools and socioeconomic background affect environmental attitudes and pro-environmental behavior of secondary school students. *Environmental Education Research, 28*, 169-196. doi:10.1080/13504622.2021.2023106

Moore, E., Wilkie, W., & Alder, J. (2001). Lighting the torch: How do intergenerational influences develop? *Advances in Consumer Research, 28*, 287-293. Retrieved from https://www.acrwebsite.org/volumes/8492/volumes/v28/NA-28/full

Movement Generation. (2022, 1 14). *Propogate, Pollinate, Practice: Curriculum tools for a just transition.* Retrieved from Movement Generation: https://movementgeneration.org/wp-content/uploads/2018/12/Propagate-Pollinate-Practice-Final.pdf

Muhlisin, M., Rosiana, I., Rahayuningsih, Y., & Suharyana, Y. (2019). The efforts to improve environmental behavior and critical thinking of students through guided inquiry-based learning on environmental education-based science. *Jurnal Penelitian dan Pembelajaran IPA, 5*(2), 202-218. doi:10.30870/jppi.v5i2.4681

Murphy, C., Smith, G., & Broderick, N. (2019). A starting point: Provide children with opportunities to engage with scientific inquiry and nature of science . *Research in Science Education*. doi:10.1007/s11165-019-9825-0

NCCA. (2009). *Aistear: the Early Childhood Curriculum Framework.* Dublin: National Council for Curriculum and Assessment. Retrieved 10 18, 2022, from https://curriculumonline.ie/getmedia/484bcc30-28cf-4b24-90c8-502a868bb53a/Aistear-Principles-and-Themes_EN.pdf

NCCA. (2020). *Draft Primary Curriculum Framework.* Dublin: National Council for Curriculum and Assessment. Retrieved 10 18, 2022, from https://ncca.ie/media/4870/en-primary-curriculum-framework-dec-2020.pdf

NCCA. (2022). *Background paper and brief for the development of Leaving Certificate Climate Action and Sustainable Development.* Dublin: National Council for Curriculum and Assessment. Retrieved 10 14, 2022, from https://ncca.ie/media/5640/background-paper-for-lc-casd_0622

NCCA. (2022). *Background paper and brief for the development of Leaving Certificate Climate Action and Sustainable Development.* Dublin: NCCA. Retrieved February 6, 2023, from https://ncca.ie/en/resources/background-paper-and-brief-for-the-development-of-leaving-certificate-climate-action-and-sustainable-development/

NCCA. (2022). *Consultation Report on the background paper and brief for the development of leaving certificate climate action and sustainable development.* Dublin: National Council for Curriculum and Assessment. Retrieved February 10, 2023, from https://ncca.ie/media/5921/bgp-casd_-consultation-report_1222.pdf

NCCA. (2022a). *Senior cycle review: Advisory report.* Dublin: National Council for Curriculum and Assessment. Retrieved 10 14, 2022, from https://ncca.ie/media/5399/scr-advisory-report_en.pdf

NCCA. (2022b). *Background paper and brief for the development of Leaving Certificate Climate Action and Sustainable Development.* Dublin: National Council for Curriculum and Assessment. Retrieved 10 14, 2022, from https://ncca.ie/media/5640/background-paper-for-lc-casd_0622

Nevin, E. (2008). Education for Sustainable Development. *Policy and Practice*, 49-63. Retrieved from https://www.developmenteducationreview.com/sites/default/files/Issue6.pdf

Nourmoradi, H., Asadi, M., Mehdi-Naghizadeh, S., Mazloomi, S., & Ghazanfari, Z. (2021). The influence of an education program on students' environmental responsibility in developing countries: evidence from Iran. *Journal of Human Behavior in the Social Environment*, 1-12. Retrieved from 10.1080/10911359.2021.1987368

Nourmoradi, H., Asadi, M., Mehdi-Naghizadeh, S., Mazloomi, S., Ghazanfari, Z., & Quam. (2021). The influence of an education program on students' environmental responsibility in developing countries: evidence from Iran. *Journal of Human Behavior in the Social Environment*, 1-12. Retrieved from 10.1080/10911359.2021.1987368

Oerke, B., & Bogner, F. (2011). Social desirability, environmental attitudes, and general ecolgoical behaviour in children. *International Journal of Science Education, 35*(5), 713-730. doi:https://doi.org/10.1080/09500693.2011.566897

Ojala, M. (2005). Adolescents' Worries about Environmental Risks: Subjective Well-Being, Values, and Existential Dimensions. *Journal of Youth Studies, 8*(3), 331-347.

Ojala, M. (2012). Hope and climate change: The importance of hope for environmental engagement among young people. *Environmental Education Research, 18*, 625-642. doi:https://dx.doi.org/10.1080/13504622.2011.637157

Ojala, M. (2012). How do children cope with global climate change? Coping strategies, engagement, and well-being. *Journal of Environmental Psychology*, 225-233. doi:10.1016/j.jenvp.2012.02.004

Ormston, R., Spencer, L., Barnard, M., & Snape, D. (2014). The foundations of qualitative research. In J. Ritchie, J. Lewis, C. Nicholls, & R. Ormston, *Qualitative research practice: A guide for social science students and researchers* (pp. 1-25). Los Angeles: Sage.

Orr, D. W. (1997). Architecture as Pedagogy. *Conservation Biology, 11*(3), 597-600. Retrieved from https://www.jstor.org/stable/2387419

Otto, S., Evans, G., Moon, M., & Kaiser, F. (2019). The development of children's environmental attitude and behaviour. *Global Environmental Change, 58*, 1-6. doi:https://doi.org/10.1016/j.gloenvcha.2019.101947

Ouellette, J., & Wood, W. (1998). Habit and intention in everyday life: The multiple processes by which past behaviour predict future behaviour. *Psychological Bulletin, 124*(1), 54-74. Retrieved from https://dornsife.usc.edu/assets/sites/208/docs/Ouellette.Wood.1998.pdf

Oyserman, D. (2015). Values, Psychology of. In J. D. Wright, *International Encyclopedia of the Social and Behavioural Sciences* (Vol. 25, pp. 36-40). Oxford: Elsevier. doi:10.1016/B978-0-08-097086-8.24030-0

Page, E. (2013). Climate Change Justice. In R. Falkner, *The Handbook of Global Climate and Environment Policy* (pp. 231-247). Chichester: Wiley-Blackwell.

Pallant, J. (2020). *SPSS survival manual: A step by step guide to data analysis using SPSS* (7th ed.). London: Routledge. doi:10.4324/9781003117452

Parahoo, K. (2014). *Nursing research: principles, process and issues* (3rd ed.). Basingstoke: Palgrave-Macmillan.

Parant, A., Pascaul, A., Jugel, M., Kerroume, M. M., & Gueguen, N. (2017). Raising students awareness to Climate Change: An illustration with binding communication. *Environment and Behaviour, 49*(3), 339-353. doi:10.1177/0013916516629191

Pasanen, T. P., Tyrväinen, L., & Korpela, K. (2014). The relationship between perceived health and physical activity indoors, outdoors in built environmnets and outdoors in nature. *Applied Psychology: Health and Well-being, 6*, 324-346. doi:https://doi-org.libraryproxy.mic.ul.ie/10.1111/aphw.12031

Payne, P. (2000). Idenitty and environmental education. *Environmental Education Research, 7*(1), 67-88. doi:10.1080/13504620124658

Pirages, D., & Ehrlich, P. (1974). *Ark II: Social response to environmental imperatives.* San Francisco: W. H Freeman and Co. .

Popper, K. (1959). *The logic of scientific discovery.* New York: Basic Books.

Prager, K. (2012). *Understanding Behaviour Change.* Edinborough : James Hutton institute.

Price, P., Jhangiani, R., Chiang, I., Leighton, D., & Cuttler, C. (2017). *Research Methods in Psychology* (3rd ed.). Seattle: Washington State University.

Pruneau, D., Doyon, A., Langis, J., Vasseur, L., Martin, G., Ouellet, E., & Boudreau, G. (2006). The Process of Change Experimented by Teachers and Students when Voluntarily Trying Environmental Behaviors. *Applied Environmental Education and Communication, 5*(1), 33-40. doi:https://doi.org/10.1080/15330150500452349

Pruneau, D., Gravel, H., Bourque, W., & Langis, J. (2003). Experimentation with a Socio-Constructivist Process for Climate Change Educatio. *Environmental Education Research, 9*(4), 429-446. doi:10.1080/1350462032000126096

Psychological Society of Ireland. (2019). *Code of Professional Ethics.* Dublin: PSI. Retrieved 4 21, 2021, from https://www.psychologicalsociety.ie/footer/Code-of-Ethics

Punter, P., Ochando-Pardo, M., & Garcia, J. (2011). Spanish secondary school students' notions on the causes and consequences of climate change. *International Journal of Science Education, 33*(3). doi:https://doi.org/10.1080/09500693.2010.492253

Reed, N., & Page, N. (2016). Changing behavior to being more environmentally friendly. In D. Winter, & N. Reed, *The Wiley handbook of personal construct psychology* (pp. 487-498). WIley-Blackwell. doi:https://doi.org/10.1002/9781118508275.ch39

Reed, N., & Page, N. (2016). Changing behavior to being more environmentally friendly. In D. Winter, & N. Reed, *The Wiley handbook of personal construct psychology* (pp. 487-498). WIley-Blackwell.

Riggs Stapleton, S. (2015). Environmental idenitty developmnet through social interactions, action and recognition. *The Journal of Environmental Education, 46*(2), 94-113. doi:10.1080/00958964.2014.1000813

Ritchie, S., Della Salla, S., & McIntosh, R. (2013). Retrieval practice, with or without mind mapping boosts fact learning in primary school children. *Plos One, 8*(11), 1-9. doi:10.1371/journal.pone.0078976

Robelia, B. A., Greenhow, C., & Burton, L. (2011). Environmental learning in online social networks: adopting environmentally responsible behaviours. *Environmnetal Education Research, 17*(4), 553-575. doi:10.1080/13504622.2011.565118

Robinson, A., Downey, L., Ford, T., Lomas, J., & Stough, C. (2019). Green teens: investigating the role of emotional intelligence in adolesccent environmentalism. *Personality and Individual Differences, 138*, 225-230. doi:10.1016/j.paid.2018.10.009

Roczen, N., Kaiser, F., Bogner, F., & Wilson, M. (2013). A competence model for environmental education. *Environment and Behavior, 46*(8), 972-992. doi:10.1177/0013916513492416

Ronaghi, M. H. (2022). The effect of virtual reality technology and education on sustainable behavior: a comparative quasi-experimental study. *Interactive technology and smart education*, 1-18. doi:http://dx.doi.org/10.1108/ITSE-02-2022-0025

Ross, H., Rudd, J., Skains, R. L., & Horry, R. (2021). How Big Is My Carbon Footprint? Understanding Young People's Engagement with Climate Change Education. *Sustainability, 13*, 1-19. doi:https://doi.org/10.3390/su13041961

Rossi, P., Freeman, H., & Lipsey, M. (1999). *Evaluation: A systematic approach* (6th ed.). Thousand Oaks CA: Sage.

Rousell, D., & Cutter-Mackenzie-Knowles, A. (2020). A systematic review of climate change education: giving children. *Children's geographies, 18*(2), 191-208. doi:10.1080/14733285.2019.1614532

Rudd, J., Horry, R., & Skains, R. L. (2020). You and CO2: a Public Engagement Study to Engage Secondary School Students with the Issue of Climate Change. *Journal of Science Education and Technology, 29*, 230-241. doi:https://doi.org/10.1007/s10956-019-09808-5

Sadler-Smith, E. (2015). Communicating climate change risk and enabling pro-environmental behavioral change through human resource development. *Advances in developing human resources, 17*(4), 442-459. doi:10.1177/1523422315601087

Saja Sanneh, E. (2018). *Systems thinking for sustainable development: Climate change and the environment.* AG: Springer. Retrieved from https://doi.org/10.1007/978-3-319-70585-9_10

Salazar, C., Jaime, M., Leiva, M., & Gonzalez, N. (2022). From theory to action: Explaining the process of knowledge attitudes and practices regarding the use and disposal of plastic among school children. *Journal of Environmental Psychology, 80*, 1-12. Retrieved from 10.1016/j.jenvp.2022.101777

Schultz, P., Gouveia, V., Cameron, L., Tankha, G., Schmuck, P., & Franek, M. (2005). Values and their relationship to environmental concern and conservation behaviour. *Journal of Cross-Cultural Psychology, 36*(4), 457-475. doi:10.1177/0022022198294003

Schwartz, S. H. (2012). Values and religion in adolescent developmnet: cross-national and comparative evidence. In G. Trommsdorff, & X. Chen, *Values, religion and culture in adoelscent development* (pp. 97-122). New York: Cambridge University Press. doi:10.1017/CBO9781139013659.007

Schwartz, S., & Howard, J. (1981). A normative decision-making model of altruism. In J. Rushton, & R. Sorrentino, *Altruism and Helping Behaviour* (pp. 89-211). Hillsdale: Lawerence Erlbaum.

Sellman, D., & Bogner, F. (2013). Effects of a 1-Day Environmental Education Intervention on Environmental Attitudes and Connectedness with Nature. *European Journal of Psychology of Education, 28*(3), 1077-1086. doi:http://dx.doi.org.libraryproxy.mic.ul.ie/10.1007/s10212-012-0155-0

Sellmann, D., & Bogner, F. (2013). Effects of a 1-day environmental education intervention on environmental attitudes and connectedness with nature. *European Journal of Psychology of Education, 28*(3), 1077-1086. doi:10.1007/s10212-012-0155-0

Senge, P. (1990). *The fifth discipline: The art and science of the learning organisation.* New York: Currency Doubleday.

Sezen-Barrie, A., Miller-Rushing, A., & Hufnagel, E. (2020). 'It's a gassy world': starting with students' wondering questions to inform climate change education. *Environmental Education Research, 26*(4), 555-576. doi:10.1080/13504622.2019.1610158

Shapiro, M. (1985). A reassessment of clinical psychology as an applied science. *British Journal of Clinical Psychology, 24*, 1-11. doi:10.1111/j.2044-8260.1985.tb01308.x

Shepardson, D., Niyogi, D., Choi, S., & Charusombat, U. (2011). Students' conceptions about the greenhouse effect, global warming and climate change. *Climatic Change, 104*, 481-507. doi:10.1007/s10584-009-9786-9

Sia, A., Hungerford, H., & Tomera, A. (1986). Selected predictors of responsible environmental behaviour: An analysis `. *The Journal of Environmental Education*, 31-40. doi:10.1080/00958964.1986.9941408

Sinatra, G., Kardash, G., Taasoobshirazi, G., & Lombardi, D. (2012). Promoting Attitude Change and Expressed Willingness to Take Action Toward Climate Change in College Students. *Instructional Science, 40*(1), 1-17.

Smith, J., & Noble, H. (2014). Bias in research. *Evidence based nursing, 17*(4), 1-2. Retrieved from https://ebn.bmj.com/content/ebnurs/17/4/100.full.pdf

Smith-Sebasto, N., & Fortner, R. (1994). The environmental action internal control index: voluntary mitigation and barriers to behaviour change. *The Journal of Environmental Education, 25*(4), 23-29. doi:10.1080/00958964. 1994.9941961.

Somerwill, L., & Wehn, U. (2022). How to measure the impact of citizen science on environmental attitudes, behaviour and knowledge? A review of state-of-the-art approaches. *Environmental Sciences Europe, 34*(18), 1-13. doi:10.1186/s12302-022-00596-1

Spitzer, S., & Weber, D. (2019). Reporting biases in self-assessed physical and cognitive health status of older Europeans. *PLoS One, 8*(14), 1-10. doi:10.1371/journal.pone.0223526

SSGA. (2020). *Carbon Footprinting: An investors toolkit.* New York: SSGA. Retrieved from https://www.ssga.com/library-content/pdfs/insights/carbon-footprinting-an-anvestor-toolkit.pdf

Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology, 29*(3), 31-42. doi:https://doi.org/10.1016/j.jenvp.2008.10.004

Stern, P. (2000). Toward a coherent theory of environmentally significant behaviour. *Journal of Social Issues, 56*(3), 407-424. Retrieved from https://web.stanford.edu/~kcarmel/CC_BehavChange_Course/readings/Stern_metareview_2000.pdf

Stevenson, K. T., Nils Peterson, M., & Bondell, H. D. (2018). Developing a model of climate change behaviour among adolescents. *Climate Change*, 1-15. Retrieved from https://doi.org/10.1007/s10584-018-2313-0

Stevenson, K. T., Peterson, N., & Bondell, H. D. (2018). Developing a model of climate change behaviour among adolescents. *Climate Change*, 1-15. Retrieved from https://doi.org/10.1007/s10584-018-2313-0

Stevenson, K., & Nils Peterson, M. (2015). Motivating action through fostering climate change hope and concern and avoiding despair among adolescents. *sustainability, 8*(1). Retrieved from https://doi.org/10.3390/su8010006

Stevenson, K., & Peterson, N. (2015). Motivating action through fostering climate change hope and concern and avoiding despair among adolescents. *sustainability, 8*(1). Retrieved from https://doi.org/10.3390/su8010006

Stevenson, K., Lashley, M., Chitwood, M., & et al. (2015). How emotion trumps logic in climate change risk perception: exploring the affective heuristic among wildlife science students. *Hum Dimens Wildl, 20*, 501-513. Retrieved from https://doi.org/10.1080/10871209.2015.1077538

Stevenson, K., Peterson, M., & Bondell, H. (2014). Overcoming skepticism with education: interacting influences of worldview and climate change knowledge on perceived climate change risk among adolescents. *Climate Change, 126*, 293-304. doi:https://doi.org/10.1007/s10584-014-1228-7

Stevenson, K., Peterson, M., Bondell, H., & et al. (2013). Overcoming skepticism with education: interacting influences of worldview and climate change knowledge on perceived climate change risk among adolescents. *Climate Change, 126*, 293-304. doi:https://doi.org/10.1007/s10584-014-1228-7

Stevenson, K., Peterson, M., Bondell, H., & et al. (2014). Overcoming skepticism with education: interacting influences of worldview and climate change knowledge on perceived climate change risk among adolescents. *Climate Change, 126*, 293-304. doi:https://doi.org/10.1007/s10584-014-1228-7

Stripple, J., & Stephan, H. (2013). Global Governance. In R. Falkner, *The handbook of global climate and environmental policy* (pp. 146-162). Chichester: Wiley-Blackwell. Retrieved from 10.1002/9781118326213.ch9

Sumrall, W., & Sumrall, K. (2021). Changing attitude into behavior: How to reduce carbon dioxide emissions. *Science Activities, 58*(1), 23-33. Retrieved from 10.1080/00368121.2021.1885334

Sund, L. (2016). Facing global sustainability issues: teachers' experiences of their own practices in environmental and sustainability education. *Environmental Education Research, 22*(6), 788-805. doi:10.1080/13504622.2015.1110744

Tallulah, T. (2018, January 10). *Individual vs Collective: Are you responsible for fixing climate change?* Retrieved from resilience: https://www.resilience.org/stories/2018-01-10/individual-vs-collective-are-you-responsible-for-fixing-climate-change/

Taylor , M., & Watts, J. (2019, October). *Revealed: the 20 firms behind a third of all carbon emissions.* Retrieved from The Guardian: https://www.theguardian.com/environment/2019/oct/09/revealed-20-firms-third-carbon-emissions

Thøgersen, J. (1996). Recycling and Morality: A critical review of the literature. *Environment and Behaviour, 28*, 546-558. doi:https://doi.org/10.1177/0013916596284006

Thomas, L. (2013, 2022 12). *Control groups and treatment groups: uses and examples.* Retrieved Feb 2, 2023, from Scribbr: https://www.scribbr.com/methodology/control-group/

Thompson, S. (2017, Feb 25). Students pull on the green jersey: The Green Schools scheme has boosted environmental awareness around Ireland. *The Irish Times*, p. 6. Retrieved 07 2022, 13, from http://libraryproxy.mic.ul.ie/login?url=https://www.proquest.com/newspapers/students-pull-on-green-jersey/docview/1871703076/se-2?accountid=55804

Timms, M. (2016, March). *The relationship between corporations and climate change.* Retrieved from World Finance: https://www.worldfinance.com/special-reports/the-relationship-between-corporations-and-climate-change

Tomlinson, Y. N. (2023, January 3). The importance of engaging with ontology and epistemology as an ECR. *Careers and employment, education, teaching and learning*. Retrieved from https://www.bps.org.uk/psychologist/importance-engaging-ontology-and-epistemology-ecr

Tonglet, M., Phillips, P., & Read, A. (2004). Using the theory of planned behaviour to investigate the determinants of recycling behaviour: a case study from Brixworth UK. *Resources, Conservation and Recycling, 41*(3), 191-214. doi:https://doi.org/10.1016/j.resconrec.2003.11.001

Transition Network. (2021, November). *Principles*. Retrieved from Transition Network: https://transitionnetwork.org/about-the-movement/what-is-transition/principles-2/

Truelove, H., & Parks, C. (2012). Perceptions of behaviours that cause and mitigate global warming and intentions to perform these behaviours. *Journal of Environmental Psychology, 32*, 246-259. doi:http://dx.doi.org/10.1016/j.jenvp.2012.04.002.

Tucker, R., & Izadpanahi, P. (2017). Live gree, think green: Sustainable school architecture and children's environmental attitudes and behaviours. *Journal of Environmental Psychology, 51*, 209-216. doi:10.1016/j.jenvp.2017.04.003

Tukker, A., & Jansen, B. (2008). Environmental impacts of products: A detailed review of studies. *Journal of Industrial Ecology, 10*(3), 159-182. doi:https://doi.org/10.1162/jiec.2006.10.3.159

UCLA. (2016). *What does Cronbach's alpha mean?* Retrieved Feb 1, 2023, from UCLA Statistical Methods and Data Analysis: https://stats.oarc.ucla.edu/spss/faq/what-does-cronbachs-alpha-mean/

UENSCO. (2021). *Getting every school climate-ready: how countries are integrating climate change issues in education.* Paris: UNESCO. Retrieved 10 14, 2022, from https://unesdoc.unesco.org/ark:/48223/pf0000379591

Uitto, A., Boeve-de pauw, J., & Saloranta, S. (2015). Participatory school experiences as facilitators for adolescents' ecological behavior. *Journal of Environmental Psychology, 43*, 55-65. doi:10.1016/j.jenvp.2015.05.007

Unal, A., Steg, L., & Granskaya, J. (2019). "To support or not to support, that is the question". Testing the VBN theory in predicting support for car use reduction policies in Russia. *Transp. Res. Part A Policy Pract, 119*, 73-81. doi:10.1016/J.TRA.2018.10.042

UNDP and University of Oxford. (2021). *People's Climate Vote.* Oxford: UNDP. Retrieved Feb 21, 2021, from https://www.undp.org/content/undp/en/home/librarypage/climate-and-disaster-resilience-/The-Peoples-Climate-Vote-Results.html

UNESCO. (2010). *Climate change education for sustainable development.* Paris: UNESCO. Retrieved from https://unesdoc.unesco.org/ark:/48223/pf0000190101.locale=en

UNESCO. (2019). *Framework for the implementation of Education for Sustainable Development (ESD) beyond 2019.* Paris: UNESCO. Retrieved from https://unesdoc.unesco.org/ark:/48223/pf0000370215?posInSet=3&queryId=193a9aaa-7167-4d98-8436-9f6361

UNESCO. (2020). *Education for Sustainable Development: A roadmap.* Paris: UNESCO. Retrieved from https://www.gcedclearinghouse.org/resources/education-sustainable-development-roadmap

UNESCO. (2020). *Education for Sustainable Development: A roadmap.* Paris: UNESCO. Retrieved 10 14, 2022, from https://unesdoc.unesco.org/ark:/48223/pf0000374802.locale=en

UNESCO. (2021). *Getting every school climate-ready: how countries are integrating climate change issues in education.* Paris: UNESCO. Retrieved 10 14, 2022, from https://unesdoc.unesco.org/ark:/48223/pf0000379591

UNESCO/UNEP. (2011). *Climate change starter's guidebook: An issues guide for education planners and practitioners.* Paris: UNESCP/UNEP. Retrieved from https://www.gcedclearinghouse.org/resources/climate-change-starters-guidebook-issues-guide-education-planners-and-practitioners?language=en

United Nations. (1992). *United Nations Framework Convention on Climate Change.* Madrid: UN. Retrieved 08 9, 2021, from https://unfccc.int/files/essential_background/background_publications_htmlpdf/application/pdf/conveng.pdf

Valdez, R., Peterson, M. N., & Stevenson, K. (2018). How communication with teachers, family and friends contributes to predicting climate change behaviour among adolescents. *Environmental Conservation, 45*(2), 183-191. doi:10.1017/S0376892917000443

Van Assche, K., Verschraegen, G., Valentinov, V., & Gruezmacher, M. (2019). The social, the ecological, and the adaptive. Von Bertalanffy's general systems theory and the adaptive governance of social-ecological systems. *Systems research and Behavioral science, 36*(3), 308-321. doi:https://doi-org.libraryproxy.mic.ul.ie/10.1002/sres.2587

van de Wetering, J., Leijten, P., Spitzer, J., & Thomaes, S. (2022). Does environmental education benefit environmental outcomes in children and adolescents? A meta-analysis. *Journal of Environmental Psychology, 81*, 1-12. doi:https://doi.org/10.1016/j.jenvp.2022.101782

van der Goot, W., Cristancho, S., de Carvalho Filho, M., Jaarsma, A., & Helmich, E. (2020). Trainee-environment interactions that stimulate motivation: A rich pictures study. *Medical Education, 54*, 242-253. doi:10.1111/medu.14019

van der Werff, E., Steg, L., & Keizer, K. (2013). The value of environmental self-identity: the relationship between biospheric values, environmental self-identity and environmental preferences, intentions and behaviour. *Journal of Environmental Psychology*, 55-63. doi:10.1016/j.jenvp.2012.12.006

Vazquez-Vilchez, M., Garrido-Rosales, D., Perez-Fernandez, B., & Fernandez-Oliveras, A. (2021). Using a Cooperative Educational Game to Promote Pro-Environmental Engagement in Future Teachers. *Education Sciences, 11*(691), 1-18. doi:10.3390/educsci11110691

Vechione, M., Schwartz, S., Davidov, E., Cieciuch, J., Alessandri, G., & Marsicano, G. (2019). Stability and change of basic personal values in early adolescence: a 2 year longitudinal study. *Journal of Personality, 88*, 447-463. doi:https://doi.org/10.1111/jopy.12502

Verplanken, B., & Aarts, H. (1999). Habit, Attitude, and Planned Behaviour: Is Habit an Empty Construct or an Interesting Case of Goal-directed Automaticity? *European Review of Social Psychology, 10*(1), 101-134. doi:https://doi.org/10.1080/14792779943000035

Vining, J., & Ebreo, A. (1992). Predicting recycling behaviour from global and specific environmental attitudes and changes in recycling opportunities. *Journal of Applied Social Psychology, 22*(20), 1580-1607. doi:10.1111/j.1559-1816.1992.tb01758.x

Wade, R. (2014). Learning for sustainability: the challenges for education policy and practice. In H. Atkinson, & R. Wade, *The challenges of sustainability: linking politics, educaiton and learning* (pp. 63-86). Bristol: Bristol Policy Press.

Wainwright, T., & Mitchell, A. (2020). *Psychology and the climate and environmental crisis.* London: British Psychological Society. Retrieved from https://cms.bps.org.uk/sites/default/files/2022-08/Clinical%20Psychology%20Forum%20332%20-%20Psychology%20and%20the%20climate%20and%20environmental%20crisis.pdf

Watkins, D., & Halton, C. (2010). *The big picture on biodiversity and climate change.* Ontario: Biodiversity and Education and Awareness Network.

Webster, M., & Sell, J. (2014). *Laboratory Experiments in the Social Sciences* (2nd ed.). New York: Elsevier. doi:https://doi.org/10.1016/C2011-0-07562-2

Wen, W., & Lu, S. (2013). Marine environmental protection knowledge, attitudes, behaviors, and curricular involvement of Taiwanese primary school students in senior grades. *Environmental Education Research, 19*, 600-619. doi:10.1080/13504622.2012.717219

Whitmarsh, L. (2008). What's in a name? Commonalities and differences in public understanding of “climate change” and “global warming”. *Public Understanding of Science, 18*(4), 401-420. doi:https://doi-org.libraryproxy.mic.ul.ie/10.1177/0963662506073088

Whyte, K. (2019). Too late for indigenous climate justice: Ecological and relational tipping points. *WIREs Climate Change*, 1-7. Retrieved from 10.1002/wcc.603

Wigfield, A., Byrnes, J., & Eccles, J. (2006). Development during early and middle adolescence. In P. Alexander, & P. Winne, *Handbook of Educational Psychology* (pp. 87-113). Mahwah: Lawrence Erlbaum Associates Publishers.

Working Group III of the IPCC. (2022). *Climate Change 2022 Mitigation of Climate Change.* Geneva: IPCC. Retrieved from https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_SPM.pdf

Wu, J., & Otsuka, Y. (2021). Pro-climate behaviour and the influence of learning sources on it in Chinese adolescents. *International research in geographical and environmnetal education, 30*(1), 24-38. doi:10.1080/10382046.2020.1761063

Yang, B., Wu, N., Tong, Z., & Sun, Y. (2022). Nature-based environmental education improves environmental awarness and environmental attitudes. *Environmental Research and Public Health, 19*, 1-19. doi:https://doi.org/10.3390/ijerph19116483

Yli-Panula, E., Jeronen, E., & Lemmetty, P. (2020). Teaching and learning methods in geography promoting sustainability. *Education Sciences, 10*(5), 1-18. doi:http://dx.doi.org/10.3390/educsci10010005

Zeidner, M., & Endler, N. (1996). *Handbook of coping: Theory, research, applications.* New York: John Wiley & Sons.

Zografakis, N., Menegaki, A., & Tsagarakis, K. (2008). Effective education for energy efficiency. *Enery Policy, 36*(8), 3226-3232. doi:10.1016/j.enpol.2008.04.021

Zsóka, A., Szerényi, Z., Szechy, A., & Kocsis, T. (2013). Greening due to environmental education? Environmental knowledge, attitudes, consumer behavior and everyday pro-environmental activities of Hungarian high school and university students. *Journal of Cleaner Production, 48*, 126-138. Retrieved from https://doi.org/10.1016/j.jclepro.2012.11.030

5.7 Appendix 7 – Information and Consent sheet – Parents

Parental information sheet and consent form

Dear Parent/ Guardian

My name is XYZ and I am currently completing the Professional Doctorate in Educational and Child Psychology in Mary Immaculate College, Limerick. I am aiming to run a 4-part climate change education programme in your child's school. A part of this programme involves asking your child to respond to questions about climate change in a survey. That is why you are being asked to consent to your child taking part in the research study.

What is this programme about?

This project aims at providing second-level students with knowledge and strategies that will meaningfully inform students about climate change. It will also support participants to develop pro-environmental strategies and techniques individually, as a class and within their communities, to help prevent the negative effects of climate change.

The project is participative, and activities based. The intervention will take the form of a series of awareness raising, practical challenges about different aspects of climate change that students will have to solve in groups. The modules that make up the programme consider:

- The causes of climate change
- Effects of climate change
- Strategies to help the community prevent further climate change causing emissions.
- Coping with climate change

Who is undertaking it?

XYZ will facilitate the programme with your child's class. A teacher from the school will supervise the programme.

Why is it being undertaken?

The objective of the study is to obtain student's perspectives on the usefulness of climate change education programmes. The programme also aims to understand if taking part in a climate change education programme leads to changes in students' attitudes, behaviour and coping skills towards climate change issues.

What are the benefits of this study?

It is hoped that participating in this study will assist in the further development of second-level educational programmes about climate change.

Exactly what is involved for the participant?

The study involves two parts:

1: Participation in a four-part climate change education module as part of their CSPE, Geography or Science Class

2: Participating students filling out a questionnaire at three different times:

- before the climate change education programme commences,
- at the end of the final education module,
- at a follow-up session 4 months later.

The questionnaire in the study will take approximately 15 minutes to complete. The purpose of the initial questionnaire is to provide the researcher with an overview of what the participants already know about climate change, together with their perceptions of, and action about, it.

Is participation in the survey anonymous?

The surveys undertaken by students are anonymous. Students will be asked to enter the last 4 digits of either their or their parents phone number so that we can compare pre and post test results however this is not linked with the name of any student on any form. As all data is anonymous, no issues in relation to the storage of sensitive personal information arise.

Does my child have to take part?

Participation in the study is voluntary. Partaking or not partaking in the questionnaire study will not have any impact on your child's results in school. Similarly, your child is free to take part in the climate change education programme but not in the survey if that's what they prefer. If they choose to do this then they don't have to complete the consent form on the next page.

This research study has received Ethics approval from the Mary Immaculate College Research Ethics Committee (MIREC) (Reference No: A22-001). If you have any concerns about this study and wish to contact an independent authority, you may contact: Mary Collins, MIREC Administrator, Mary Immaculate College, Limerick Telephone: 061-204980 E-mail: mirec@mic.ul.ie

If your child is unsure or worried about any aspects of the intervention or the survey, they can ask their teacher about it or else they can get in touch with the researcher or else the researchers' supervisor using the following details:

Researcher	Name	**Supervisor**	Dr. Name
	Email		Email
	Phone		Phone

Title of Project: Climate Change Education Programme Research

Name of Researcher: James Groarke

		Please initial box
1.	I confirm that I have read the information sheet for the above study and have had the opportunity to ask questions. I have given my child the opportunity to ask any questions on the research also	□
2.	I am satisfied that I understand the information provided and have had enough time to consider the information.	□
3.	I understand that my child's participation is voluntary and that they are free to withdraw at any time, without giving any reason. I have explained this to my child.	□
4.	I agree for my child to take part in the above study.	□

_____

Name of Participant

_____ _____ _____

Parents/ Guardians Name Date Signature

Parents/ Guardians Name Date Signature

5.8 Appendix 8 – Information and Consent sheet – School

Institutional Permission Request Form

Dear Principal,

My name is XYZ and I am completing a professional doctorate in Educational and Child psychology in Mary Immaculate College, Limerick. I have received Garda vetting from Mary Immaculate College. I have experience working with children and adolescents and of delivering therapeutic interventions. As part of my doctoral thesis, I am conducting research into the effects and efficacy of climate change education programmes in secondary schools. I am trying to understand the effect that a climate change education programme has on the pro-environmental behaviour, attitudes and coping styles of participating students.

I would be grateful if you would consider allowing me to run this programme in your school and allowing me to seek consent from students and their parents to allow them to take part in the study.

This project would involve me facilitating four climate change learning modules with students. These modules could take part over two mornings or afternoons or else it can be provided through four 80-minute sessions. The four modules that make up the programme consider:

- The causes of climate change
- Effects of climate change
- Strategies to help with climate change

- Coping with climate change

The project is participative and psychoeducational in nature. Ideally, some part would be nature-based also although this depends on the school setting. The intervention will take the form of a series of awareness raising, practical challenges about different aspects of climate change that students will have to solve in groups. The activity will be facilitated by the researcher and be student-led. It ties in aspects of the CSPE and Geography curriculum and the outcomes from the programme can be used as part of the classroom-based assessments in these subjects that make up the Junior Cycle Profile of Achievement.

If possible, I would appreciate the opportunity to run this programme with two different classes at two different times. This would allow me to collect pre and post results from two different groups. If this were possible, I would be happy to run the programme in May, 2022 for the first group and then again in September, 2022 for the second group. As part of the study, students would be asked to complete a questionnaire before, during and then 4 months after the intervention. This will take approximately 15 minutes and would necessitate students having access to a tablet or computer. Participation in the programme is voluntary and students who agree to participate can of course withdraw from the programme at any time also. Any date gathered through the project will be stored according to the Mary Immaculate College Data Retention Policy. Analysed date will be used for the findings of the thesis and may also be disseminated to others in research articles or other formats.

This research study has received Ethics approval from the Mary Immaculate College Research Ethics Committee (MIREC) (quote reference number when you have received it). If you have any concerns about this study and wish to contact an independent authority, you may contact: XYZ MIREC Administrator, Mary Immaculate College, Limerick Telephone: 061-204980 E-mail: mirec@mic.ul.ie.

If you have any queries or concerns about the study, please contact me or my project supervisor, XYZ. Please find enclosed an information sheet for participants and their parents which goes into more detail about the study. If you are interested in running this programme in your school, I would appreciate you contacting me at this email address: climatechangeproject22@gmail.com.

Kind regards,

XYZ

5.9 Appendix 9 - Principal Consent Sheet

Title of Project: Climate change education programme

Name of Researcher: XYZ

Please Tick	Please Read
	I confirm that I have read the information sheet for the above study and have had the opportunity to ask questions on this research
	I am satisfied that I understand the information provided and have had enough time to consider the information
	I understand that the school will have to distribute consent sheets to the students taking part in the modules
	I understand that students are participating voluntarily in this research and that they are free to withdraw at any time without giving any reason.
	I agree for this school: _____ to take part in the research
	I have filled out the short survey here: https://forms.gle/VWmxhyXD1dJcYgku7 to provide information about the school

_____ _____ _____

Name of Principal Date Signature

Researcher

5.10 Appendix 10 – Information sheet and Assent Form -Student

Student Information Sheet

Dear Student,

Climate change is something that is being discussed more and more. This discussion is being held in the Dáil, on our television screens, in our communities, on the streets, and, of course, in our schools as well.

My name is XYZ and I am learning how to be an educational psychologist which means I am interested in learning about how to help children and teenagers.

I am going to run a programme on learning and coping with climate change. You can join in on this programme if you choose. This programme is like an SPHE class. It has a lot of group activities where we learn about climate change together and share and improve our knowledge and attitude about climate change also.

Before you decide if you want to be a part of the programme, please consider the following:

What is this programme about?

This is a course about Climate Change. It will help you to understand why climate change happens and what you and your community can do to reduce the problems caused by climate change.

Who will be teaching me?

This is a student led programme. It will be facilitated by me, James Groarke as well as your teacher.

Why is it being undertaken?

We want to understand how students can change their own attitudes and behaviour towards reducing climate change and change other people's attitudes and behaviour in their communities.

What are the benefits of this study?

We'll use the results of this research to develop environmental and climate change education modules.

What will I have to do?

You will have to fill out two or three online surveys and take part in 4 climate change education modules. The surveys should only take 15-20 minutes each.

Is the survey anonymous?

The surveys are anonymous. You will be asked to enter the last 4 digits of either their or their parents phone number so that we can compare pre and post test results. Data from the surveys are not linked with the name of any student on any form. As all data is anonymous, no issues in relation to the storage of sensitive personal information arise.

Do I have to take part?

Participation in the study is voluntary. You only have to do the survey if you want to. You will only be able to take it if you fill out the consent form.

This research study has received Ethics approval from the Mary Immaculate College Research Ethics Committee (MIREC) (quote reference number when you have received it). If you have any concerns

about this study and wish to contact an independent authority, you may contact: XYZ, MIREC Administrator, Mary Immaculate College, Limerick Telephone: 061-204980 E-mail: mirec@mic.ul.ie

Student assent form

Dear Student,

Climate change is something that is being discussed more and more. This discussion is being held in the Dáil, on our television screens, in our communities, on the streets, and, of course, in our schools as well.

My name is XYZ and I am learning how to be an educational psychologist which means I am interested in learning about how to help children and teenagers.

I am going to run a programme on learning and coping with climate change. You can join in on this programme if you choose. This programme is like an SPHE class. It has a lot of group activities where we learn about climate change together and share and improve our knowledge and attitude about climate change also.

Before you decide if you want to be a part of the programme, please read the information sheet with your parents and make sure you understand the following

Tick	Please read
	I know I don't have to take part in the group or other activities if I don't want to
	I know if I want to stop at any time that that's okay

	I know this isn't a test or exam and that I am taking part in this programme to learn about ways to cope with climate change and to help decide if other students can learn from this programme
	I know I will be asked to complete an online questionnaire three times during the programme

If you are not sure on anything you can ask me any questions you might have

Do you want to take part in this research? (Please circle response) YES NO

Signed: _____

Date: _____

5.11 Appendix 11 - Transformed values of data information sheet

Questions 4.1 – 4.8 Climate Change Hope

4.1 I believe people will be able to stop global warming

4.2 I believe scientists will be able to find ways to solve problems caused by climate change

4.3 Even when some people give up, I know there will be people who will continue to try to solve problems caused by climate change

4.4: Because people can learn from our mistakes, we will influence climate change in a positive direction.

4.5: Every day, more people care about problems caused by climate change.
4.6: If everyone works together, we can solve problems caused by climate change.
4.7At the present time, I am energetically pursuing ways to solve problems caused by climate change.
4.8: I know that there are many things that I can do to help solve problems caused by climate change.

1	I strongly Disagree
2	I disagree
3	Neutral
4	I agree
5	I strongly Agree

Questions 5 – CC Concern
5.1: How worried are you about global warming?

Not at all worried	4
A little worried	3
Somewhat worried	2
Very worried	1

5.2: How much do you think global warming will harm you personally?

Not at all	4
Only a little	3

A moderate amount	2
A great deal	1

5.3: When do you think global warming will start to harm people in Ireland?

Being harmed now	1
In ten years	2
In 25 years	3
Om 50 years	4
Om 1—years	5
Never	6

5.4: How much do you think global warming will harm future generations of people?

Not at all	4
Only a little	3
A moderate amount	2
A great deal	1
Don't know	0

Questions 6 pro environmental behaviour

Always	1
Usually	2
Sometimes	3
Occasionally	4
Never	5

6.1 How often do you... Turn off the lights at home when they are not in use

6.2 How often do you... Ask my family to recycle some of the things we use

6.3 How often do you... Ask other people to turn off the water when it is not in use

6.4 How often do you... Close the refrigerator door while I decide what to get out of it

6.5 How often do you... Recycle at home

6.6 How often do you... Choose and environmental topic when I can choose a topic for an assignment in school 6

6.7 How often do you... : Talk with my parents about how to do something about environmental problems

6.8 How often do you... Ask others about things I can do about environmental problems

6.9 How often do you... Walk for transportation

7.0 How often do you... Bike for transportation

Questions 7 climate change hope

Strongly Agree	**1**
Agree	**2**
Neutral	**3**
Disagree	**4**
Strongly Disagree	**5**

If everybody makes changes to their lifestyles and behaviour, we can reduce the effects of climate change]

It is my responsibility to reduce the amount of carbon dioxide that I put into the environment]

It is very important for me to act in a way that reduces my impact on the environment and on the climate]

Strongly Agree	**5**
Agree	**4**
Neutral	**3**
Disagree	**2**
Strongly Disagree	**1**

There is no point in trying to change my behaviour, as nothing I do will have any real effect on climate change]

Changing my behaviour is pointless, as we cannot really know what the climate will be like in the future]

Question 8 – human/environmental/selfish/hedonistic perspective

7.1: It is important to you to prevent environmental pollution]

[7.2: It is important to protect the environment]

7.3: It is important to respect nature]

7.4: It is important to be in unity with nature]

7.5: It is important that every person has equal opportunities]

7.6: It is important to take care of those who are worse off]

7.7: It is important that every person is treated justly]

[7.8: It is important that there is no war or conflict

7.9: It is important to be helpful to others]

[7.10: It is important to have fun]

7.11: It is important to enjoy life's pleasures]

7.12: It is important to do things that you enjoy]

7.13: It is important to have control over others€™s actions]

7.14: It is important to have authority over others]

[7.15: It is important to be influential]

[7.16: It is important to have money and possessions]

7.17: It is important to work hard and be ambitious]

5.12 Appendix 12 – Additional information on test instruments

Table S1. Climate change knowledge scale (n = 1041). We drew these questions from Tobler et al. (2012) and modified quesitons based on pretesting with middle school students (n = 92). Porportion correct represents the porportion of respondents whose answers reflect current scientific understanding on the pretest. Scale-level Cronbach's alpha measures were 0.60 and 0.63 on the pre- and post-survey, respectively. Item-level Cronbach's alpha meaures below represent the alpha if the item were excluded.

Topic	Item wording		Proportion Correct	SD	Item Level Cronbach's alpha
Climate Change Science	Burning oil, among other things, produces carbon dioxide (CO_2)	*Pre-test*	0.79	0.41	0.58
		Post test	0.81	0.39	0.61
	Carbon dioxide (CO_2) is a greenhouse gas.	*Pre-test*	0.73	0.44	0.59
		post-test	0.83	0.37	0.62
	Greenhouse gases warm the Earth by trapping some heat that would otherwise escape into the atmosphere.	*Pretest*	0.76	0.43	0.58
		Posttest	0.79	0.41	0.61
	The ozone hole is the main cause of the greenhouse effect.	*Pretest*	0.65	0.48	0.61
		Posttest	0.63	0.48	0.64
	Weather and climate are different names for the same thing.	*Pretest*	0.75	0.43	0.57
		Posttest	0.81	0.39	0.61
	At the same quantity, carbon dioxide (CO_2) is more harmful to the climate than methane.	*Pretest*	0.62	0.49	0.61
		Posttest	0.61	0.49	0.65
		Pretest	0.81	0.39	0.57

Climate Change Causes	The global carbon dioxide (CO_2) concentration in the atmosphere has increased during the past 250 years.	*Posttest*	0.84	0.37	0.61
	The increase of greenhouse gasses is mainly caused by human activities	*Pretest*	0.75	0.43	0.58
		Posttest	0.76	0.43	0.61
	With a high probability, the increase of carbon dioxide (CO_2) is the main cause of climate change.	*Pretest*	0.55	0.50	0.59
		Posttest	0.68	0.47	0.62
	Climate change is mainly caused by natural variations (such as changes in solar radiation and volcanic eruptions)	*Pretest*	0.58	0.49	0.57
		Posttest	0.61	0.49	0.61

Topic	**Item wording**		**Proportion Correct**	**SD**	**Item Level Cronbach's alpha**
	The last century's global increase in temperature was the largest in the last 1000 years.	*Pretest*	0.63	0.48	0.57
		Posttest	0.67	0.47	0.61
	The Earth's climate has changed naturally in the past, therefore humans are not the cause of global warming.	*Pretest*	0.69	0.46	0.56
		Posttest	0.74	0.44	0.60
	The decade from 2000 to 2009 was warmer than any other decade in over 150 years.	*Pretest*	0.61	0.49	0.58
		Posttest	0.63	0.48	0.60

	Global warming will stop as soon as we stop producing greenhouse gasses.	*Pretest*	0.75	0.43	0.59
		Posttest	0.76	0.43	0.61
Change Impacts Climate	*For the next few decades, the majority of climate scientists expect…*				
	… an increase in extreme events, such as droughts, floods, and storms	*Pretest*	0.77	0.42	0.58
		Posttest	0.79	0.41	0.61
	… a warmer climate to increase the melting of polar ice, which will lead to an overall rise of the sea level.	*Pretest*	0.78	0.41	0.57
		Posttest	0.80	0.40	0.60
	… the climate to change evenly all over the world.	*Pretest*	0.69	0.46	0.59
		Posttest	0.69	0.46	0.62
	… a precipitation increase in every region worldwide.	*Pretest*	0.57	0.50	0.61
		Posttest	0.55	0.50	0.64
	… changes in animal migration patterns	*Pretest*	0.78	0.41	0.57
		Posttest	0.77	0.42	0.60
	… wildlife communities to move toward the poles.	*Pretest*	0.37	0.48	0.60
		Posttest	0.45	0.50	0.65
	…. some places to get wetter, while others get drier	*Pretest*	0.82	0.38	0.59
		Posttest	0.81	0.39	0.61

Table S2. Item factor loadings for the climate change hope scale (n = 1041, α = 0.80). Each item associated with a 7-point Likert scale ranging from (1) strongly disagree to (7) disagree, with an additional choice of "I do not see climate change as a problem." Respondents who chose "I do not see climate change as a problem) were excluded from analysis. Scale-level Cronbach's alpha measures were 0.80 and 0.82 on the pre- and post-survey, respectively. Item-level Cronbach's alpha meaures below represent the alpha if the tiem were excluded.

Item		Mean	SD	Cronbach's alpha	Factor loadings
I believe people will be able to stop global warming.	*pretest*	3.93	1.73	0.79	0.60
	posttest	3.92	1.73	0.80	0.61
I believe scientists will be able to find ways to solve problems caused by climate change.	*pretest*	4.89	1.70	0.77	0.70
	posttest	4.71	1.63	0.79	0.70
Even when some people give up, I know there will be people who will continue to try to solve problems caused by climate change.	*pretest*	5.40	1.72	0.78	0.66
	posttest	5.19	1.67	0.79	0.72
Because people can learn from our mistakes, we will influence climate change in a positive direction.	*pretest*	4.41	1.72	0.78	0.66
	posttest	4.30	1.58	0.79	0.71
Every day, more people care about problems caused by climate change.	*pretest*	3.98	1.64	0.79	0.60
	posttest	4.01	1.50	0.80	0.65

If everyone works together, we can solve problems caused by climate change.	*pretest*	4.85	1.87	0.76	0.77
	posttest	4.75	1.77	0.78	0.77
At the present time, I am energetically pursuing ways to solve problems caused by climate change.	*pretest*	3.03	1.62	0.80	0.46
	posttest	3.14	1.56	0.83	0.40
I know that there are many things that I can do to help solve problems caused by climate change.	*pretest*	4.39	1.78	0.77	0.70
	posttest	4.40	1.64	0.79	0.70

Table S3. Item factor loadings for the climate change concern scale (n = 1041, α = 0.66). Numbers beside each answer choice represent coding used. Scale-level Cronbach's alpha measures were 0.66 and 0.66 on the pre- and post-survey, respectively. Item-level Cronbach's alpha meaures below represent the alpha if the tiem were excluded.

Question		Mean	SD	Cronbach's alpha	Factor Loadings
How worried are you about global warming? a) Very worried (4) b) Somewhat worried (3) c) Not very worried (2) d) Not at all worried (1)	*Pretest*	2.28	0.85	0.57	0.77
	Posttest	2.44	0.83	0.56	0.78
How much do you think global warming will harm you personally? a) Not at all (1) b) Only a little (2) c) A moderate amount (3) d) A great deal (4)	*Pretest*	2.01	0.85	0.60	0.71
	Posttest	2.06	0.88	0.59	0.73
When do you think global warming will start to harm people in the United States? a) They are being harmed now (5) b) In 10 years (4) c) In 25 years (3) d) In 50 years (2) e) In 100 years (1) f) Never (0)	*Pretest*	3.14	1.33	0.64	0.65
	Posttest	3.34	1.29	0.63	0.66
How much do you think global warming will harm future generations of people? a) Not at all (1) b) Only a little (2) c) Don't know (3) d) A moderate amount (4) e) A great deal (5)	*Pretest*	2.16	1.44	0.58	0.73
	Posttest	3.60	1.18	0.60	0.70

Table S4. Item factor loadings for the pro-environmental behavior scale (n = 1041, α = 0.74). Each item associated with a 5-point frequency Likert scale ranging from (1) never to (5) always. Scale-level Cronbach's alpha measures were 0.75 and 0.76 on the pre- and post-survey, respectively. Item-level Cronbach's alpha meaures below represent the alpha if the item were excluded.

				Item-level	Factor Loadings		
Item		**Mean**	**SD**	**Cronbach's alpha**	**Personal action**	**Information Seeking**	**Transportation**
Turn off the lights at home when they are not in use	*Pretest*	4.07	0.94	0.73	0.63		
	Posttest	4.01	1.04	0.75	0.78		
Ask my family to recycle some of the things we use	*Pretest*	2.83	1.39	0.69	0.74		
	Posttest	2.91	1.36	0.71	0.83		
Ask other people to turn off the water when it is not in use	*Pretest*	3.22	1.39	0.72	0.59		
	Posttest	3.21	1.43	0.73	0.70		
Close the refrigerator door while I decide what to get out of it	*Pretest*	3.06	1.52	0.74	0.50		
	Posttest	3.06	1.47	0.74	0.63		
Recycle at home	*Pretest*	3.30	1.51	0.72	0.70		
	Posttest	3.26	1.51	0.74	0.89		
Choose and environmental topic when I can choose a topic for an assignment in school	*Pretest*	1.77	0.92	0.71		0.75	
	Posttest	1.87	1.00	0.74		0.81	
Talk with my parents about how to do something about environmental problems	*Pretest*	2.32	0.94	0.74		0.68	
	Posttest	2.25	0.94	0.75		0.64	
Ask others about things I can do about environmental problems	*Pretest*	1.92	0.98	0.72		0.81	
	Posttest	1.91	0.98	0.73		0.83	
Walk for transportation	*Pretest*	2.45	1.07	0.74			0.85
	Posttest	2.48	2.19	0.75			0.84
Bike for transportation	*Pretest*	2.20	1.11	0.74			0.83
	Posttest	1.05	1.08	0.75			0.84

Table S5. Item factor loadings for the EPVQ Scale ($\alpha = 0.88 - 0.68$). Each item associated with a 5-point frequency Likert scale ranging from (1) not important to (5) very important Scale-level Cronbach's alpha measures were 0.75 and 0.76 on the pre- and post-survey, respectively. Item-level Cronbach's alpha meaures below represent the alpha if the item were excluded.

	Factor	Cronbach's Alpha
It is important to you to prevent environmental pollution	Biospheric	0.76
It is important to protect the environment	Biospheric	0.81
It is important to respect nature	Biospheric	0.76
It is important to be in unity with nature	Biospheric	0.64
It is important that every person has equal opportunities	Altruistic	0.48
It is important to take care of those who are worse off	Altruistic	0.50
It is important that every person is treated justly	Altruistic	0.58
It is important that there is no war or conflict	Altruistic	0.21
It is important to be helpful to others	Altruistic	0.47
It is important to have fun	Hedonic	0.71
It is important to enjoy the life's pleasures	Hedonic	0.61
It is important to do things that you enjoy	Hedonic	0.55
It is important to have control over other's actions	Egoistic	0.47
It is important to have authority over others	Egoistic	0.49
It is important to be influential	Egoistic	0.55
It is important to have money and possessions	Egoistic	0.41
It is important to work hard and be ambitious	Egoistic	0.45

Table S6. Two Major environmental values Instrument 5-point Likert scale (1: I totally disagree, 5: I totally agree)

		Maximum likelihood factor analysis
Preservation Values	It upsets me to see the countryside taken over by building sites.	0,71
	I enjoy trips to the countryside.	0,65
	Humankind will die out if we don't live in tune with nature.	0,65
	Society will continue to solve even the biggest environmental problems.	0,65
	Sitting at the edge of a pond watching dragonflies in flight is enjoyable.	0,65
	I save water by taking a shower instead of a bath (in order to spare water).	0,61
	I always switch the light off when I don't need it.	0,60
	We must set aside areas to protect endangered species.	0,59
Utilisation Values	Worrying about the environment often holds up development problems.	0,55
	We need to clear forest in order to grow crops.	0,59
	Nature is always able to restore itself.	0,37
	Our planet has unlimited resources.	0,52
	We must build more roads so people can travel to the countryside.	0,52
	Only plants and animals of economical importance need to be protected.	0,53
	Humans have the right to change nature as they see fit.	0,47

	People worry too much about pollution.	0,52

Table S7: Climate Change Efficacy Statements

1	There is no point in trying to change my behaviour, as nothing I do will have any real effect on climate change	
2	If everybody makes changes to their lifestyles and behaviour, we can reduce the effects of climate change	
3	It is my responsibility to reduce the amount of carbon dioxide that I put into the environment	
4	Changing my behaviour is pointless, as we cannot really know what the climate will be like in the future	
5	It is very important for me to act in a way that reduces my impact on the environment and on the climate	

5.13 Appendix 13 – SIG submission to NCCA

28/10/2022

Subject: Public Consultation on the development of Leaving Certificate Climate Action and Sustainable Development. Observations on background paper from the Psychological Society of Ireland's (PSI) Special Interest Group for Addressing Climate and Environmental Emergency

Background

The PSI Special Interest Group for Addressing Climate and Environmental Emergency brings together psychologists from the Republic of Ireland who have expertise and interest in raising public awareness of climate change and the environmental emergency and how psychology can help us understand and resolve these issues.

Our SIG strongly supports the promotion of climate awareness and action through formal and informal education. We welcome the proposed Leaving Certificate subject as a key step in fostering a sense of agency, commitment and hope among our younger generations.

We recognise the central role psychological, behavioural and social factors have in the creation of, mitigation of and adaption to climate change and therefore suggest a focus on these factors throughout.

We welcome the proposed curriculum development and have outlined our observations on the background paper hereafter. Our Group is available to further contribute to the curriculum development as deemed appropriate to further the above goal.

Observations on the purpose of Leaving Certificate Climate Action and Sustainable Development

This is an impressive background document outlining the rationale for a much needed second level education subject. The generation that is currently studying at this level are central to Ireland's efforts to reach net zero emissions by 2050. At some point in the future, as this and later generations focus more and more human, economic, and technological resources on this existential task, they will no doubt look back and occasionally curse their elders for landing them in this predicament. It is our hope that they will also thank entities such as the Department of Education's NCCA for acting to prepare their generation in whatever way they could when they did.

The LCCASD mentions how other jurisdictions place a strong emphasis on student's learning to develop skills and to take informed, independent action with relation to climate change and sustainable development issues (p20). Similarly, the development of the new specification highlights the need to understand the relevance of climate action on their daily lives and the relevance and importance of the

skills developed through the subject for the 21st century (p28).We strongly encourage the specification to include an exploration of the economic and social systems and values through which unchecked climate change has been allowed to occur throughout the 20th century. An understanding of the student's own relationship to those systems and a clear contrast and comparison to a new biospheric system based on sound ecological and environmental values encompassed in the language of adaptation and mitigation should be central to any course specification also.

It would be beneficial to incorporate a separate specification, perhaps based on the new NEPS Wellbeing framework (e.g. the Hobfall principals), that considers the importance of student's learning to cope with climate change. Such a specification should include a discussion of why climate change can be different and sometimes even more difficult to cope with in comparison to other pressing life problems. This could also focus on the practice of meaning focused coping techniques to help students graduate from secondary school with a sense of hope for the future, despite the existential threat that climate change encompasses[1]. Similarly, the specification should be informed by how different types of coping skills, underpinned by different emotions such as hope or concern, can lead to more or less pro-environmental behaviour on the part of students[2].

To what degree do you think a curriculum specification for Leaving Certificate Climate Action and Sustainable Development should provide opportunities for the following:

- Developing students' climate literacy
- Engaging with the sustainable development goals
- Complement the whole school and cross-curricular approaches to ESD
- Use learning from a range of disciplines (e.g. science, business and the arts) to solve problems and develop solutions
- Developing students' skills to effectively engage with climate action and sustainable development issues
- Engaging with local, national and global climate/sustainability issues

Any new curricular subject should increase participating students' understanding and literacy in that area. Unfortunately, the research shows that an increase in knowledge about the science of climate change doesn't necessarily translate into an uptake in pro-environmental attitudes or adaptation and mitigation behaviours[3]. The Knowledge Structure Model, suggests that three levels of knowledge are needed before a person starts to demonstrate effective pro-environmental behaviours:

1. Systems Knowledge – how different variables within a system relate and interact with each other, such as how methane produced by cows causes an increase in global temperatures.

2. Action Knowledge - how a person comprehends what type of action or behaviour might influence a given environmental situation. A student understanding that consuming local produce leads to a smaller carbon footprint which in turn leads to less of an impact on the climate in general

3. Effectiveness knowledge – the relative gain associated with a given behaviour. If we all write a letter to my local TD about bike paths, will he speak out in the Dáil about the issue, and will a bike path between the school and town centre be built?[4]

Reflecting this, UNESCO break down the informational material in a curriculum to include the following:

1. System Strand: What the climate change and the greenhouse effect are

2. Action Strand: How human behaviours can impact, mitigate and adapt to climate change

3. Effectiveness Strand: Which behaviours are most effective in meeting a particular mitigation or adaption goal [5]

The final two points, *developing students' skills to effectively engage with climate action and sustainable development issues* and *engaging with local, national and global climate/sustainability issues* can be considered as very related to the action and effectiveness strands. It is for this reason that we strongly agree with the inclusion of a focus on these two factors while also agreeing with the inclusion of the other points. In short, any course should ensure that students are graduating with an awareness of how their current lifestyles impact on climate change and mitigation and adaptation measures. The course should also develop, through student centred group work and practical activities the ability to increase their biospheric actions both individually, with other students in school, and within the community.

We note in the background document a paucity of considerations about experiential or hands-on learning via immersive experiences, spending time observing and interacting with nature, or carrying out practical activities in nature (e.g., gardening, working with biodiversity or wildlife). Experiential learning provides opportunities for both knowledge acquisition and transformational thinking via active experimentation and reflective observation. Embedding practical and experiential elements to the curriculum can be an invaluable way to help students develop values and emotional connections which in turn can foster both learning and behaviour.

Observations on the opportunities for Leaving Certificate Climate Action and Sustainable Development to support the cross-curricular and whole-school approaches to ESD in schools

The importance of linking with community and national bodies cannot be underestimated. There is strong evidence to show that learning about climate change from experts in the field increases students' understanding and acting on pro-environmental behaviours[6][7]. It also increases the likelihood of students seeing the climate change emergency more from a scientific perspective and less from an

ideological perspective[8]. The importance of place-based learning also needs to be considered with some research suggesting that just talking about nature within nature is far more effective in encouraging climate change behaviours in students than more traditional classroom based approaches. Many ESD programmes in other countries (Austria, Germany, China) actually bring students to an area being affected by climate change to witness changes for themselves and to talk to members of their community who have seen radical changes over their lifetime.

Many students are apathetic about climate change and some psychologists suggest that students are often apathetic about the issue when their families are either apathetic or don't believe that human caused climate change exists[9]. Using a whole school approach to normalise new beliefs and attitudes involving anthropogenic climate change can in turn have a knock-on behavioural effect on students' mitigation and adaptation behaviours not only in the school[10] but at home as well.[11]

Observations on the opportunities for Leaving Certificate Climate Action and Sustainable Development to capitalise on the resources and initiatives currently available in the cross-curricular and whole-school ESD space?

As well as increased participation in whole-school activities such as the Green Schools initiative there are many climate change specific activities that can be carried out across the whole school, such as measuring the schools' carbon or eco footprint as has been carried out in the USA and the Middle East. This activity could be a logical first step in identifying areas which the school can increase their mitigation activities at school-wide level.

Schools should be encouraged to take part in the Irish Schools Sustainability Network, an organisation where teachers and students meet monthly to discuss new ideas and initiatives. Schools can also be encouraged to take part in the ECO-UNESCO climate ambassadors programme which leads to both class and whole-school climate change mitigation activities. These programmes can, in turn be linked with activities in different subjects in the senior cycle curriculum including, geography, business, technology, home economics and politics and society as well as programmes in the Leaving Cert vocational programme.

Observations on the opportunities to enable student voice and action through the development of a specification for Leaving Certificate Climate Action and Sustainable Development?

As noted in the New Zealand Curriculum in particular, this is arguably the most important aspect of any new senior cycle subject considering climate change. The climate change emergency necessitates a radical shift in individual and collective thinking and behaviour as well as radical changes in many societal norms. This includes how Irish people eat, how we travel, how we shop, where and how we work and where and how we build houses to name but a few. Ireland's young people, like young people everywhere, can be highly innovative change-makers. Our secondary schools are the perfect environments in which to provide the space and the technical expertise of scientist-facilitators to ensure students have the self-belief and efficacy to work collectively to achieve this change.

There is evidence suggesting that the provision of knowledge either to children or adults isn't enough by itself to ensure pro-environmental behavioural change. Students needs to actualise many different processes before they start making environmental changes in their own lives and within the communities that they are a part of. These factors include the need to feel:

- Sensitive to environmental changes
- Personally invested in the issue of climate change and their local environment
- That the environmental decisions they make will be reinforced and supported by the adults around them
- That they have knowledge of and the proper skills to use environmental action strategies
- A strong intention to act[12]

It is hoped that these aspects as well as an in-depth knowledge of climate change mitigation and adaptation solutions would be placed at the core of any leaving certificate subject dealing with the topic.

There is a danger too that students will move from feeling concerned to being overwhelmed or powerless about the issue of climate change. Students can prevent this from occurring by becoming aware of what they can do on the different levels – individual, family, schoolwide, community, nationally and internationally.

Notably, a participatory consultation approach putting students and pupils at the centre of the conversation about curriculum changes should be considered. Younger generations have grown up with greater exposure to the climate crisis than previous generations did; it is part of their language, their understanding of the world. They certainly have an important stake in how the subject should be developed. A consultation with existing and previous students is recommended to ensure that the student voice is actually heard in the curriculum development and that a sense of agency is fostered among students.

Yours, sincerely

Psychological Society of Ireland's (PSI) Special Interest Group for Addressing Climate and Environmental Emergency

Email: climatechange@psychologicalsociety.ie

References

[1] Mahm Chapman, Arkowitz, & Lickel, *Coping with Climate Change…*, 2020

[2] Ojala, Coping with climate change among adolescents, 2013

[3] Kollmuss & Agyeman, *Mind the gap. Why do people act environmentally?*, 2002

[4] Frick, Kaiser, & Wilson, *Environmental knowledge and conservation behaviour*, 2004

[5] UNESCO, *Climate Change Education for Sustainable Development*, 2010

[6] UNESCO, Education for sustainable development: a roadmap, 2020

[7] Monroe et al., Identifying effective climate change education strategies, 2017

[8] Arya & Maul, The building of knowledge, language and decision making about climate change science, 2016

[9] Ojala, Coping with climate change among adolescents, 2013

[10] Deisenrieder et al., bridging the action gap by democratising climate change education, 2020

[11] Zografakis et al., Effective education for energy efficiency, 2008

[12] Michie et al, Mapping behavioural determinants to behaviour change techniques. 2008

5.14 Appendix 14 Examples of posters created by students

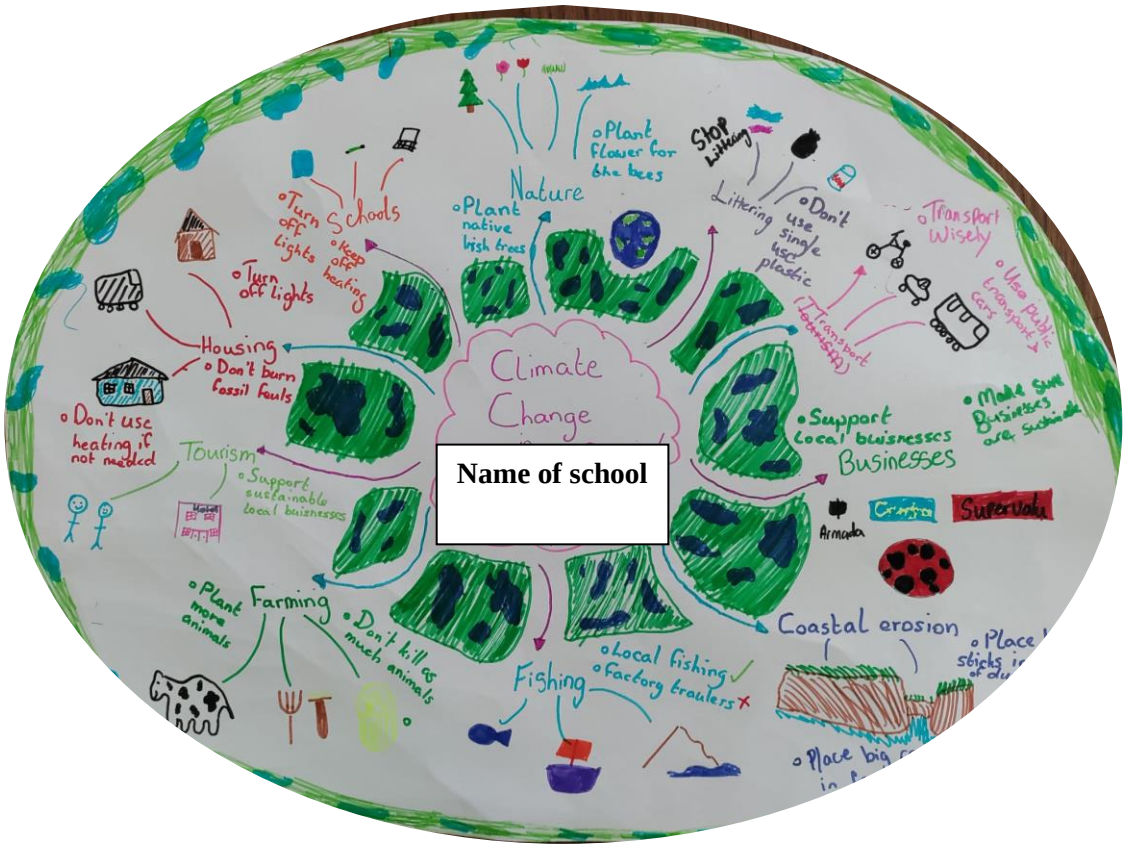


Figure 15: Participant poster 1 detailing mitigation and adaptation measures at family, local, and national level

Figure 16: Participant poster 2 detailing local mitigation and adaptation measures

Figure 17: Participant poster 3 detailing local mitigation and adaptation measures

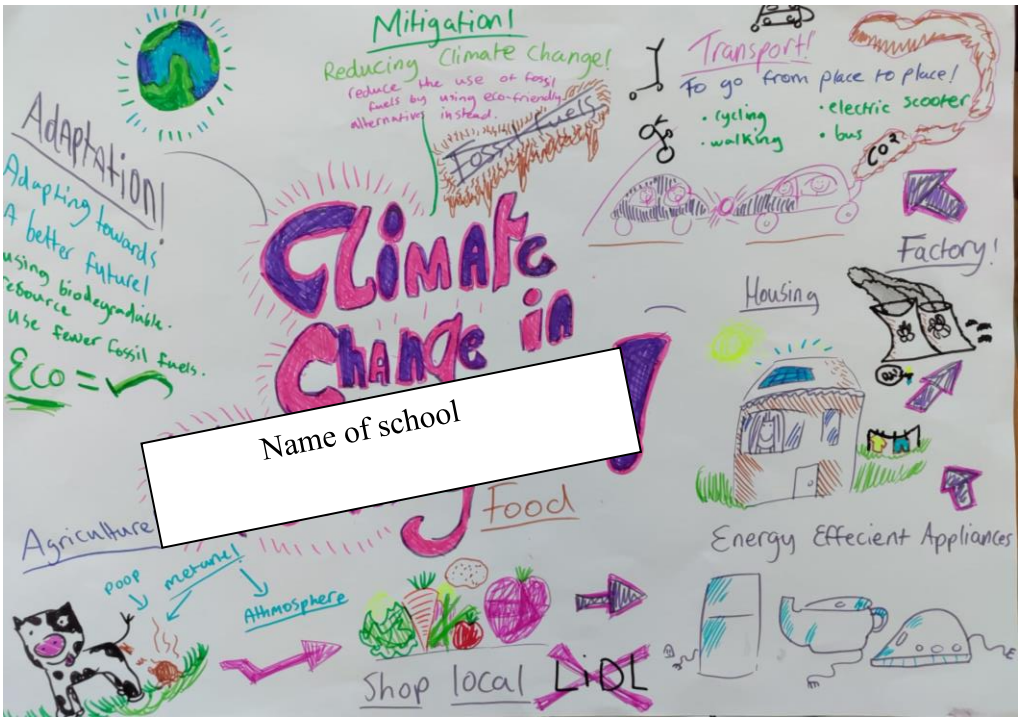
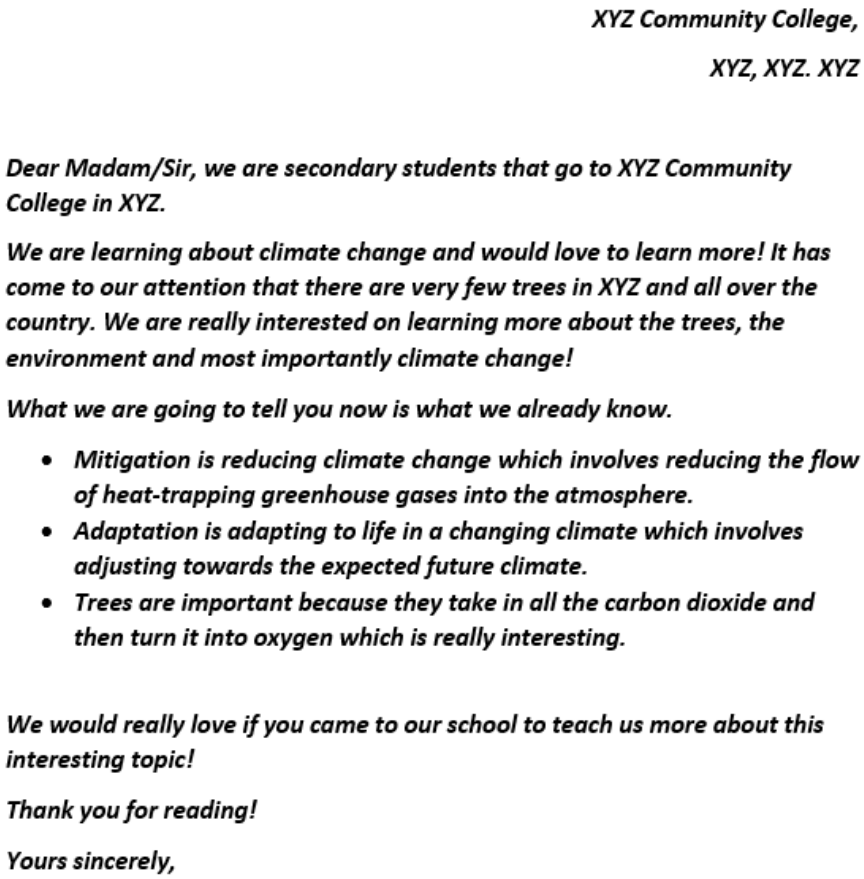


Figure 18: Participant poster 4 highlighting systems knowledge

Figure 19: Participant poster 5 highlighting conflation of littering and bee disappearances with climate change

5.15 Appendix 15 Examples of letters drafted by students



XYZ Community College,

XYZ, XYZ. XYZ

Dear Madam/Sir, we are secondary students that go to XYZ Community College in XYZ.

We are learning about climate change and would love to learn more! It has come to our attention that there are very few trees in XYZ and all over the country. We are really interested on learning more about the trees, the environment and most importantly climate change!

What we are going to tell you now is what we already know.

- *Mitigation is reducing climate change which involves reducing the flow of heat-trapping greenhouse gases into the atmosphere.*
- *Adaptation is adapting to life in a changing climate which involves adjusting towards the expected future climate.*
- *Trees are important because they take in all the carbon dioxide and then turn it into oxygen which is really interesting.*

We would really love if you came to our school to teach us more about this interesting topic!

Thank you for reading!

Yours sincerely,

Figure 20: Letter 1 written to national charity requesting assistance to plant trees to off-set carbon

XYZ Community College

XYZ Rd

XYZ

16/11/2022

Dear Sir/Madam

We are second year students at XYZ Community College and we would like to learn more about climate change and we want to plant some trees with your company here are some facts about climate change. Trees intake CO2 and release O2, meaning more trees allows for less CO2 to stay in the atmosphere. Trees are really important for Bio-Diversity.

We believe trees are a very important part of mitigation of climate change, and would like to volunteer to be a helping hand in climate change in the form of planting trees. As we are genuinely concerned about the CO2 levels in the Irish atmosphere and after continuous study of climate change we truly understand the importance of planting trees.

It would be our greatest honour if you could accept our invitation to come and help us plant trees at our school. Thank you for your time and we truly appreciate you reading this letter and we hope that we hear back from you on this topic

Yours Sincerely

Figure 21: Letter 2 written to national charity requesting assistance to plant trees to offset carbon