ResearchGate

See discussions, stats, and author profiles for this publication at: https://www.researchgate.net/publication/374556654

# Towards a more sustainable future: simple recommendations to integrate planetary health into education

**Article** *in* The Lancet Planetary Health · October 2023

DOI: 10.1016/S2542-5196(23)00194-8

CITATIONS
4

READS
84

**2 authors:**

Salvador Baena Morales
University of Alicante
**120** PUBLICATIONS **560** CITATIONS
SEE PROFILE

Andreas Fröberg
University of Gothenburg
**61** PUBLICATIONS **3,724** CITATIONS
SEE PROFILE

All content following this page was uploaded by Salvador Baena Morales on 10 October 2023.

The user has requested enhancement of the downloaded file.

# Towards a more sustainable future: simple recommendations to integrate planetary health into education

*Salvador Baena-Morales, Andreas Fröberg*

**This Personal View presents recommendations aimed at integrating planetary health into various stages of education, which are simple but effective, and designed with teachers in training and those who have not yet considered how to incorporate UNESCO's Education for Sustainable Development into their teaching practice. However, the constantly evolving nature of the Education for Sustainable Development programme must be recognised, and the importance of being able to adapt teaching methods to meet the changing needs of students as they progress through their educational journey should be highlighted. Therefore, this Personal View considers the cognitive, social, and ethical evolution of students and offers specific recommendations for preschool, primary, secondary, and university education levels. We recommend that educators should focus on teaching students to critically evaluate data on sustainability and to develop innovative solutions to environmental challenges. We also highlight the importance of incorporating practical projects, using active methods that promote skills related to caring for the planet, or the importance of situated learning that attends to the particularities of each context. In this way, students can develop skills and values that contribute to a more sustainable future. The recommendations made here aim to provide educators and researchers with simple but effective ways to integrate planetary health into education.**

*Lancet Planet Health* 2023; 7: e868–73

**Department of General Didactics and Specific Didactics, Faculty of Education, University of Alicante, Alicante, Spain** (S Baena-Morales PhD); **Department of Physical Education, Faculty of Education, Valencian International University, Valencia, Spain** (S Baena-Morales); **Department of Food and Nutrition and Sport Science, University of Gothenburg, Gothenburg, Sweden** (A Fröberg PhD)

Correspondence to:
Dr Andreas Fröberg, Department of Food and Nutrition and Sport Science, University of Gothenburg, Gothenburg SE-405 30, Sweden
**andreas.froberg@gu.se**

or

Dr Salvador Baena-Morales, Department of General Didactics and Specific Didactics, Faculty of Education, University of Alicante, Alicante 03690, Spain
**salvador.baena@ua.es**

## Introduction

The intersecting issues of climate change, biodiversity loss, and social inequality, pose serious and complex challenges for human health and wellbeing.[1] Given the urgent challenges posed by climate change, biodiversity loss, and social inequality, education emerges as a key tool for addressing these multifaceted issues. Here we address the role of the educational system, starting with strategies that do not depend on being implemented by educational institutions, which facilitates more rapid implementation. In this regard, Monroe and colleagues[2] analysed that climate change education is based on two approaches, one that is solely fact-based and another that also promotes action. Fact-centred approaches are predominant for numerous reasons, such as the politicisation of the issue, but we argue that knowledge alone is not sufficient to motivate sustained engagement in environmental issues by students. Rather, educational approaches that foster students' ability to perceive and adapt to changing environments or circumstances, and provide them with opportunities to act, are needed.

Throughout history, education has reflected the main ways of life and contemporary concerns. Examples include the integrated theocentrism that was present in educational processes during the period between the fifth to the 15th century, or the prominence of humanism that characterised the Renaissance (during the 15th and 16th centuries).[3] Currently, we live in an anthropocentric society, in which certain types of human actions are causing biological and geophysical changes on a global scale.[4] These global environmental changes interest with imbalance in access to and use of the resources, accentuating social injustice necessitating that planetary health becomes a collective priority. However, we believe that the educational system does not fully and adequately address the demands that this context requires, showing how deeply rooted anthropocentric tendencies are, even among some of the most environmentally conscious educators.[3] Traditionally, research and major institutions have agreed that teaching about sustainability and integrating it into the educational system requires çdigm shift in education.[5] True change would entail a reorientation of educational systems, policies, and practices so that students engage in sustainability issues and make culturally appropriate and locally relevant action decisions, but this is a considerable challenge. Therefore, while appropriate strategies are being sought, environmental issues continue to grow, necessitating actions that do not overburden educators and are urgently integrated. Otherwise, only teachers who are interested and concerned about planetary health will be able to develop actions aimed at improving the planet.

In the search for solutions to this issue, previous studies have described various generic frameworks for guiding planetary health within the educational system. For example, we can highlight the twelve cross-cutting principles for promoting education based on planetary health.[6] Another notable proposal is One Health, which aims to integrate a planetary health model into higher education on the basis of principles of inclusivity and a holistic perspective, creating an effective reinforcement cycle in transdisciplinary thinking.[7] However, we believe that proposals should be based on the search for specificity in ecoeducational policies that are adapted to the evolutionary needs of students and each educational specialty. Therefore, throughout this Personal View, in addition to considering the student needs at the different stages of development, we also emphasise that not all knowledge is acquired in the same way.

Education has great transformative potential to address the threats of climate change, but we need educational designs that foster the development of awareness, the ability to act, and the promotion of change.[2] These designs should be based on a combination of principles and

theories of human development learning, as well as taking into account general knowledge about sustainability and environmental awareness, always emphasising that the development of skills and competencies must be in accordance with the stages of student development and attending to the maturation of neurological structures related to learning at each stage.[8] To support this concept, consider the process of acquiring new skills or understanding complex concepts; for instance, learning to roller skate or swim. These physical skills are best mastered at younger ages when motor skills are rapidly developing, and fear is less of a constraint. The mastery of these skills relies heavily on physical coordination and, to a lesser extent, on intellectual or abstract reasoning. However, comprehending complex physics problems demands a level of abstract reasoning that is not typically fully developed in early childhood. Cognitive structures at younger ages might not be sufficiently mature to process such abstract and complex information.[9] Therefore, there are preferential age ranges for the acquisition of different types of knowledge. When seeking to improve environmental literacy, it is important to consider the learner's age, the knowledge we aim to impart, and the competencies we strive to develop. For instance, during adolescence, a phase of life marked by the establishment of personal identity and exploration of novel experiences, it might be more beneficial to focus on fostering social, emotional, and communication skills alongside environmental awareness.[10] Learning activities during this stage could include collaborative projects on local environmental issues or engaging in environmental advocacy campaigns, thereby nurturing both socioemotional skills and environmental literacy. In contrast, adulthood is often characterised by the development of logical and critical thinking skills, enabling the acquisition of abstract and complex concepts related to our world. At this stage, environmental education could delve deeper into complex topics such as climate change, biodiversity loss, and sustainability strategies. Whereas in adulthood, logical and critical thinking begins to develop, allowing for the acquisition of abstract and complex concepts related to the world around us.[11] The adult learners could engage in debates, problem-solving tasks, or policy making simulations that demand a high level of critical thinking and a deep understanding of environmental science. Therefore, a nuanced approach that considers these age-related cognitive and developmental aspects can effectively improve environmental literacy at all stages of education. Different contexts require different educational measures.

## The student in planetary health: a lifelong learning

Education for planetary health is an approach that advocates for lifelong and continuous learning, from early childhood and throughout adulthood. During this process, some authors, such as Stone and colleagues,[6] have pointed out the integration of knowledge into curricula as essential for better equipping students to collaborate across disciplines and develop sustainable solutions for environmental challenges. However, it seems that even with sufficient knowledge about sustainability, students still lack the necessary drive to turn this knowledge into actions that truly contribute to the planet's health.[12] That is why this education must add to its objectives the provision of essential competencies that go beyond knowledge acquisition. Some competencies have already been described in relation to UNESCO's Education for Sustainable Development and should not only cover skills for environmental care but also an improvement in social and emotional awareness and actions, through competencies such as critical thinking and collaboration.[13] The development of critical thinking and collaboration have been mentioned as part of the 4 Cs of modern education—communication, collaboration, creativity, and critical thinking—designed to serve as a reference in the formation of individuals capable of facing the challenges of the 21st century.[14] By incorporating these skills into environmental education, we can cultivate more aware and more active citizens in their concern for the environment. Moreover, these skills are also essential for addressing environmental challenges on a global level, as they could enable students to understand environmental problems, collaborate across different communities and disciplines, and seek creative and sustainable solutions.

To achieve this competency development in students, it is essential to create learning situations on the basis of methodologies in which students are active, make decisions, and participate communally.[15,16] To reach this goal, teachers must use teaching methods that facilitate student involvement in decision making. For example, project-based learning offers a comprehensive approach based on providing real solutions to a problem. Also, structuring learning based on service-learning should be considered, in which teaching results in a direct contribution to society through volunteering.[17] This type of educational design, in which the students are the focus of learning, is more in tune with the idea of lifelong learning that endures and, most importantly, transfers to the unique needs of each student's environment. These more experiential learnings are based on the idea that learning is more effective when it involves exploration and active participation, rather than passive exposure to information.[18] In addition to this idea, priority should be given to teachings that address environmental issues that are relevant to the students, generating situated learning. UNESCO highlights this idea, stating that "we should enjoy and expand the educational opportunities that take place throughout life and in different cultural and social spaces".[19] This requires the inclusion of actions not only in the classroom but also in natural environments close to the students, such as parks, gardens, wilderness areas, farmlands, and forests—any place where there are other

forms of life beyond humans. In the framework of this idea, Guzmán and colleagues[20] already defended the importance of situated learning, presenting a framework for environmental education that promotes connection between local communities in the pursuit of a prosperous environment for all.

Therefore, a learning focused on planetary health could be more effective when it is meaningful and relevant to the student (adapted to their developmental stage), involving active and collaborative participation, and critical reflection of their context through the problems of the nearby environment. Thus, adapting the educational programme to the previous conditions of the audience is considered one of the most important rules in education on climate change. Therefore, to enable effective education on sustainability, it is crucial to understand the context and the students, and thus design educational programmes according to their specific needs and characteristics.[21]

## Recommendations for each developmental stage of students

In addition to highlighting the need for more active and situated education, every educational process should be tailored to the evolutionary needs of each stage of learning. Consequently, the priorities that a health-centred education should have in primary education are different from in higher education. Each stage of human development has its own peculiarities and characteristics in terms of learning. For example, young children have a greater capacity to learn through play and exploration, whereas teenagers might benefit more from reflection and dialogue, and university students might be more prone to learning through experience and practice. Therefore, the integration of sustainability into education on the basis of generic educational models should be avoided, and it would be appropriate to reference models that have been designed on the basis of the psychoevolutionary needs of the various stages of learning. We consider it essential to analyse these differences when designing educational processes, as this can help maximise the learning potential of each student and enable a change in consciousness for sustainable development. As Guzman and colleagues,[20] report, the training of students in the field of planetary health should begin early, but not in the same way. In this sense, during childhood development, neurophysiological changes occur that allow for the acquisition of increasingly complex knowledge, but at the same time, the capacity of boys and girls to obtain more learning is limited.[9] Once content load is reached, the changes are more functional than structural, until adolescence or adulthood is reached. It is at this moment in which there is a process of optimisation of the functioning of the built structures, which allows for more complex learning and the development of much deeper ideas and thoughts (eg, reasoning and critical thinking).[22] Therefore, considering the psychoevolutionary needs of students in their different educational stages, we propose a series of simple recommendations for teaching planetary health.

During the preschool stage, children are developing a basic understanding of the world around them and the relationships between things. It is important to teach them about the environment in a simple and playful way, focusing on the importance of caring for the planet and the natural resources,[23] so that environmental education in the preschool stage can be a meaningful experience for children's development. Participation in practical activities, such as picking up litter in the park or planting trees, can help children develop a sense of responsibility towards the environment and foster a cheerful outlook towards nature. Additionally, children at this stage are very visual and tactile, so it is important to involve them in activities that allow them to have a direct experience with nature because it can increase children's awareness of environmental issues and foster a greater sense of responsibility. In summary, outdoor education can help children develop a positive attitude towards nature and foster a sense of emotional connection with the environment.[24] Hence, during the preschool stage, children can be taught about the importance of caring for the planet with practical activities that involve direct experiences with nature.[25,26]

As children continue to develop, they might begin to have a greater sense of responsibility towards the environment. In fact, during the process of environmental education, early childhood (up to the age of 8 years) has been identified as a particularly crucial time to develop environmental literacy.[27] Accordingly, during this stage, it might be important to teach about how biodiversity conservation occurs and how individual actions can impact the planet.[28,29] Students at this stage begin to be more aware of the interconnectedness between living beings and their environment, becoming more sensitive to environmental issues and how human actions can affect ecosystems and the animals that inhabit them.[30] In addition, it could be useful to teach about the importance of renewable energy and how each person can contribute to a more sustainable future or to integrate learning focused on the 3 Rs (reduce, reuse, recycle).[31] Furthermore, children at this stage have a greater capacity to understand abstract concepts and are more critical in their thinking.[32] Therefore, it is important to provide clear and accurate information about environmental challenges, while also presenting simple actions that can potentially contribute to their solution (such as saving water). In addition, involving them in practical projects that allow them to apply the concepts learned and see their effects could also be considered an appropriate strategy for this stage of development.[33] For these reasons, the primary stage is an opportune moment to involve children in practical projects that allow them to analyse the effects of their own actions on the environment. And always trying to promote positive experiences in children, since enjoying natural environments during childhood, can lead to a greater proenvironmental attitude.[34]

As students move from primary to secondary education, they develop a deeper understanding of environmental challenges and how human actions can affect the environment.[8] This highlights the importance of teaching high-school students about pressing environmental issues, such as climate change and environmental degradation, and how these challenges can be addressed through sustainable solutions.[35] Furthermore, students at this stage have a greater ability to analyse and question information, so the development of critical thinking about environmental issues could be addressed.[36] This stage becomes an opportunity to initiate the development of skills that involve informed decision making (eg, via projects, solidarity actions, problem-based learning, and case analysis) contextualised in environmental issues.[18] It is also important to involve them in research and problem-solving projects in which they can apply the concepts learned and develop skills to work collaboratively in teams. However, secondary education is a stage in which more differences arise among adolescents in terms of sociocultural background, values, and interests;[21] this entails a special emphasis on adapting teaching to the needs of each educational context. For example, it has been shown that the socioeconomic environment of young people could be decisive, since adolescents whose parents have a high social status might be more interested in sustainable development and environmental issues.[37] Therefore, the secondary education stage is especially important to teach and act on the most urgent, close, and palpable environmental issues, delving into how these challenges could be addressed through sustainable solutions; developing critical and research skills in students through educational projects that are completed through a real resolution.

In previous stages, the importance of developing skills and competencies (soft skills) that could contribute to environmental issues, environmental challenges, and the search for sustainable solutions has been highlighted. However, during university education, learning becomes much more technical and specialised (hard skills), which implies a teaching context with a greater conditioning factor than previous stages, in which the curricula usually do not include specific sustainability issues.[38] Under this context, it should be considered the importance of teaching about the relationship between their degree and environmental policies at national and international levels, and how they can be applied to address environmental challenges (eg, ways to contribute to the 17 UN Sustainable Development Goals and their 169 specific targets).[39] Additionally, students at this stage have an advanced ability to analyse and question information, so it is important to teach them to critically evaluate sustainability data and develop skills to formulate innovative solutions to environmental challenges.[16] This is the stage in which the teaching of environmental policies and how they can be applied to address environmental challenges become important. Developing critical and research skills in students through interconnected practical projects that culminate in the solution to complex problems will also be emphasised. In this sense, volunteering campaigns or the integration of service-learning methodologies focused on the framework of planetary health could be suitable strategies for the university stage.[17]

As argued, Education for Sustainable Development is a process that constantly evolves, adapts, and changes according to students' needs. Therefore, it is important to consider that students' understanding, and awareness capacity evolves as they progress in their educational process, and their perception of ethics and social consciousness differs depending on their age and context. Additionally, their content load and ability to understand abstract concepts will be an essential aspect to consider when designing educational interventions. In this sense, it is essential for teachers to adapt their teaching approach to meet the specific needs of each educational stage. When appropriate, students should also be challenged with pedagogically sound and contextually interesting educational interventions with support from their teacher. However, simple recommendations can be effective, such as the integration of practical projects, promoting outdoor education, and teaching environmental policies. Consciousness in sustainability and planetary health not only has a positive effect on the environment but can also contribute to developing skills and values that students will carry with them in their daily lives and in their future jobs and roles in society. Under this approach, a series of general recommendations have been proposed that aim to respond to each educational period based on dimensions in constant evolution, such as ethical sense, social consciousness, content load, and abstraction level (figure). In addition to this perspective, promoting a more sustainable and transformative education entails recalibrating our relationship with nature, a notion briefly touched upon in our figure but worth a deeper exploration. The human-nature disconnect poses a significant hurdle to sustainability, requiring educational strategies that mend this bond. Methods vary with age: for younger students, sensory exploration and direct nature interactions foster appreciation, whereas older students can delve into ecosystems, biodiversity, and human-environmental effects. This approach surpasses mere sustainability data transmission or innovative problem-solving promotion, nurturing a profound understanding and sense of belonging with nature, influencing lifelong attitudes and behaviours. Infusing this nature sensitivity into education establishes a base for a healthier, more sustainable human-nature relationship, enabling education to play a pivotal role in repairing this connection and ensuring future generations live in harmony with our planet.

The educational community is not yet fully prepared to make the necessary changes that an education that centres nature should entail. Until now, many large and structural changes have been proposed, we argue that it

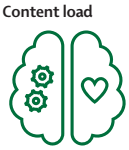
| | Education for sustainable development during preschool stage | Education for sustainable development during primary stage | Education for sustainable development during secondary stage | Education for sustainable development during higher education stage |
|---|---|---|---|---|
| **Ethical sense** | To encourage students' natural curiosity and interest in the world around them through activities and games that are engaging and fun. | Children continue to develop their sense of ethics, learning about the importance of responsibility and integrity. Fostering empathy and understanding of sustainability perspectives can be integrated. Developing students' autonomy and responsibility in projects and activities related to planetary health. | Students are developing a more complex ethical sense, beginning to question and analyse their own values and ethical principles. It is important to encourage critical reflection and dialogue to foster self-awareness and reflection on students' personal values and beliefs through activities and discussions that promote competencies such as critical thinking. | Consolidated ethical thinking that enables complex sustainability issues to be addressed in a critical and reflective manner. The learning environment should be based on exploration, reflection, and ethical problem solving. Encourage self-awareness and reflection on students' personal values and beliefs through activities and discussions that promote critical thinking and social responsibility. |
| **Social awareness** | Involve students in making simple, enjoyable decisions, such as choosing what activity to do next or how to help care for the school garden. | Continued development of social and moral awareness, learning the importance of rules and social responsibility. Empathy and understanding of others' perspectives to help them develop a strong social conscience. They can develop more complex decision making, such as choosing a group project or participating in volunteering activities. | More complex awareness of social and moral norms as these norms are questioned and analysed. Critical reflection and dialogue should be encouraged. This will enable more complex and systematic decision making (eg, the planning and design of sustainability projects at community level). | Strong social and ethical awareness, enabling them to address complex social and ethical issues in a critical and reflective manner. Providing a learning environment that encourages exploration, reflection, and environmental problem solving is also important. Involve students in more complex and systematic decision making (eg, participate in the planning and design of sustainability projects at community or international level). |
| **Content load**  | Consider the students' stage of cognitive development and provide activities and games that are appropriate to their age and ability. Young children have a greater capacity to learn through play and exploration. | Harnessing children's capacity to learn and assimilate information at this stage is essential. Teach basic concepts about the environment, such as recycling, responsible consumption, and conservation of natural resources. | They begin to develop critical and abstract thinking skills. It is important to encourage analysis and reflection on environmental issues, such as climate change and pollution. | Deepen specific knowledge and skills: university students have the capacity to analyse and understand more advanced and complex concepts. Sustainability can be taught in relation to their area of study, fostering the development of specific and professionally applicable skills. |
| **Abstraction level** | Limited capacity for abstraction, and their understanding is based mainly on immediate and concrete experience. Use simple language and practical activities to understand environmental concepts. Encourage exploration and discovery learning. | To participate in group projects involving exploration and problem solving related to the environment (eg, conservation of energy or the importance of natural resources). | To participate in research projects and internships that address structurally more complex sustainability issues (eg, global environmental challenges). | Highly developed capacity for abstraction. Understand and analyse complex environmental concepts from an interdisciplinary and critical perspective. Develop innovative solutions to environmental challenges through research and professional practices that address sustainability issues in an interdisciplinary manner. |

***Figure:*** **Recommendations for each educational period based on the ethical sense, social awareness, content load, and abstraction level**

is better to start with simpler and more realistic actions. This idea of seeking educational recommendations based on concrete actions was reflected in the 2022 27th UN Climate Change Conference, where it is emphasised that the collective priority should shift from evidence gathering to the establishment of real forms of action that can be implemented in education. We believe that it is not necessary to teach updated content or spend more time on new teaching methods, but rather to readapt and orient the content that each teacher already teaches, but always with sustainability in mind. Just as teachers have been required to adapt to innovative technologies, we now believe that it is time for education to address the needs that the health of the planet requires. Teachers should not be solely tasked with the responsibility of infusing education with planetary health principles; it is a broader initiative that demands robust curricula, resources, and a solid foundation in professional training. In conclusion, this Personal View is intended to offer an initial framework for educators in the nascent stages of their career or those who are beginning to implement sustainable development themes into their programmes. However, although these fundamental recommendations provide a good starting point, the full-fledged integration of Education for Sustainable Development into pedagogical practices required more complex strategies. For such intricacies to be effectively addressed and implemented, the proactive engagement and leadership of educational administrators and policy makers is of crucial importance. Therefore, we recognise the onus of implementing planetary health principles in education should not fall solely on individual teachers. As such, we stress the necessity for systemic shifts in educational frameworks and curriculum initiatives at a national and global level. Endorsements from international bodies such as UNESCO and OECD, and a focus on country-specific curricula, could catalyse a more comprehensive adoption of these principles. Today's students will have to face these growing problems in the future, and we believe that education focused on the needs of students is key to ensuring more prosperous and sustainable actions in the coming years.

For more on the **27th UN Climate Change Conference** see https://www.un.org/en/climatechange/cop27

**Contributors**
SB-M contributed to the conceptualisation, formal analysis, methodology, visualisation, and writing of the original draft. SB-M and AF contributed to the review and editing of the manuscript.

**Declaration of interests**
We declare no competing interests.

**Acknowledgments**
There was no funding source for this report.

**References**

1 Romanello M, Di Napoli C, Drummond P, et al. The 2022 report of the *Lancet* Countdown on health and climate change: health at the mercy of fossil fuels. *Lancet* 2022; **400:** 1619–54.
2 Li CJ, Monroe MC. Exploring the essential psychological factors in fostering hope concerning climate change. *Environ Educ Res* 2019; **25:** 936–54.
3 Ross N. Anthropocentric tendencies in environmental education: a critical discourse analysis of nature-based learning. *Ethics Educ* 2020; **15:** 355–70.
4 Lewis SL, Maslin MA. Defining the anthropocene. *Nature* 2015; **519:** 171–80.
5 UNESCO. Education for sustainability: from Rio to Johannesburg, lessons learnt from a decade of commitment. Paris: UNESCO, 2002.
6 Stone SB, Myers SS, Golden CD. Cross-cutting principles for planetary health education. *Lancet Planet Health* 2018; **2:** e192–93.
7 Villanueva-Cabezas JP, Winkel KD, Campbell PT, Wiethoelter A, Pfeiffer C. One Health education should be early, inclusive, and holistic. *Lancet Planet Health* 2022; **6:** e188–89.
8 Blakemore S-J. Adolescence and mental health. *Lancet* 2019; **393:** 2030–31.
9 Goswami U. Neuroscience and education: from research to practice? *Nat Rev Neurosci* 2006; **7:** 406–11.
10 Luyckx K, Schwartz SJ, Berzonsky MD, et al. Capturing ruminative exploration: extending the four-dimensional model of identity formation in late adolescence. *J Res Pers* 2008; **42:** 58–82.
11 Snowman J, McCown R. Psychology applied to teaching. Boston, MA: Cengage Learning, 2011.
12 Radwan AF, Khalil EMAS. Knowledge, attitude and practice toward sustainability among university students in UAE. *Int J Sustain High Educ* 2021; **22:** 964–81.
13 Rieckmann M, Mindt L, Gardiner S. Education for Sustainable Development Goals learning objectives. Paris: UNESCO, 2017.
14 Supena I, Darmuki A, Hariyadi A. The influence of 4C (constructive, critical, creativity, collaborative) learning model on students' learning outcomes. *Int J Instr* 2021; **14:** 873–92.
15 Baena-Morales S, González-Víllora S. Physical education for sustainable development goals: reflections and comments for contribution in the educational framework. *Sport Educ Soc* 2023; **28:** 697–713.
16 Portuguez Castro M, Gómez Zermeño MG. challenge based learning: innovative pedagogy for sustainability through e-learning in higher education. *Sustainability* 2020; **12:** 4063.
17 García-Rico L, Martínez-Muñoz LF, Santos-Pastor ML, Chiva-Bartoll O. Service-learning in physical education teacher education: a pedagogical model towards sustainable development goals. *Int J Sustain High Educ* 2021; **22:** 747–65.
18 Bentz J, O'Brien K. Art for change: transformative learning and youth empowerment in a changing climate. *Elementa* 2019; **7:** 52.
19 International Commission on the Futures of Education. Reimagining our futures together: a new social contract for education: executive summary. Paris, UNESCO, 2022.
20 Guzmán CAF, Aguirre AA, Astle B, et al. A framework to guide planetary health education. *Lancet Planet Health* 2021; **5:** e253–55.
21 Kuthe A, Keller L, Körfgen A, Stötter H, Oberrauch A, Höferl K-M. How many young generations are there? A typology of teenagers' climate change awareness in Germany and Austria. *J Environ Educ* 2019; **50:** 172–82.
22 Diamond A. Executive functions. *Annu Rev Psychol* 2013; **64:** 135–68.
23 Yıldız TG, Öztürk N, İyi TI. Educating for sustainability in early childhood education: a systematic review. *Environ Educ Res* 2021; **27:** 796–820.
24 Johnson B, Činčera J. Relationships between outdoor environmental education program characteristics and children's environmental values and behaviors. *JAEOL* 2023; **23:** 184–201.
25 Daries J, Engdahl I, Otieno L, Pramling-Samuelson I, Siraj-Blatchford J, Vallabh P. Early childhood education for sustainability: recommendations for development. *Int J Early Child* 2009; **41:** 113–17.
26 Grindheim LT, Bakken Y, Hauge KH, Heggen MP. Early childhood education for sustainability through contradicting and overlapping dimensions. *ECNU Rev Educ* 2019; **2:** 374–95.
27 North American Association for Environmental Education. Early childhood environmental education programs: guidelines for excellence. Washington, DC: North American Association for Environmental Education, 2016.
28 Larimore R. Defining nature-based preschools. *Int J Early Child Environ Educ* 2016; **4:** 32–36.
29 Wilson R. Nature and young children: encouraging creative play and learning in natural environments. London: Routledge, 2007.
30 Sánchez-Llorens S, Agulló-Torres A, Del Campo-Gomis FJ, Martinez-Poveda A. Environmental consciousness differences between primary and secondary school students. *J Clean Prod* 2019; **227:** 712–23.
31 So WWM, Chow SCF. Environmental education in primary schools: a case study with plastic resources and recycling. *Education* 2019; **47:** 652–63.
32 Trott CD. Children's constructive climate change engagement: empowering awareness, agency, and action. *Environ Educ Res* 2020; **26:** 532–54.
33 Rosa CD, Profice CC, Collado S. Nature experiences and adults' self-reported pro-environmental behaviors: the role of connectedness to nature and childhood nature experiences. *Front Psychol* 2018; **9:** 1055.
34 Cheng JC-H, Monroe MC. Connection to nature: children's affective attitude toward nature. *Environ Behav* 2012; **44:** 31–49.
35 Gericke N, Boeve-de Pauw J, Berglund T, Olsson D. The Sustainability Consciousness Questionnaire: the theoretical development and empirical validation of an evaluation instrument for stakeholders working with sustainable development. *Sustain Dev* 2019; **27:** 35–49.
36 Heberle AE, Rapa LJ, Farago F. Critical consciousness in children and adolescents: a systematic review, critical assessment, and recommendations for future research. *Psychol Bull* 2020; **146:** 525–51.
37 Stevenson KT, Peterson MN, Bondell HD. The influence of personal beliefs, friends, and family in building climate change concern among adolescents. *Environ Educ Res* 2019; **25:** 832–45.
38 Figueiró PS, Raufflet E. Sustainability in higher education: a systematic review with focus on management education. *J Clean Prod* 2015; **106:** 22–33.
39 Baena-Morales S, Prieto-Ayuso A, Merma-Molina G, González-Víllora S. Exploring physical education teachers' perceptions of Sustainable Development Goals and education for sustainable development. *Sport Educ Soc* 2022; **27:** 1–18.

© 2023 The Author(s). Published by Elsevier Ltd. This is an Open Access article under the CC BY 4.0 license.



View publication stats