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Can learning to move foster sustainable development? A systematic literature review examining the potential of sport and physical activity in the context of environmental and sustainability education

Introduction

Sport and physical activity (PA) have been increasingly discussed as possible positive enhancers of sustainable development (SD), understood as "development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs" (UN, 1987) (Lindsey & Chapman, 2017; Triantafyllidis & Mallen, 2022). In recent years, several researchers have identified potential contributions of sport and PA to achieving the United Nations' Sustainable Development Goals (SDGs) (UNOSDP, 2014). For example, Nigg and Nigg (2021) argued that sport and PA are beneficial for an individual's well-being regardless of age, gender or ethnicity, hence directly contributing to SDG 3 'Good Health and Well-Being'. Likewise, the potential of sport and PA in peacebuilding (SDG 16 'Peace, Justice, and Strong Institutions') has been pointed out (Gadais, Decarpentrie, Charland, Arvisais, & Paquito, 2022). With regard to SDG 5 'Gender Equality', sport can certainly also offer learning opportunities. The UNESCO (2015) highlighted that women's participation in sport can challenge various stereotypes commonly associated with women. Through the medium of sport, women and girls can showcase their talents and achievements by highlighting their skills and abilities. In this way, the participants' self-esteem and self-confidence are strengthened. However, the exclusionary potential of sport must also be cautioned at this point (Greve & Süßenbach, 2022; Heckemeyer, 2018). Similarly, sport infrastructure can of course be made sustainable (SDG 11, 'Sustainable Cities and Communities'; Eßig, 2018), and sport clubs and associations can make their infrastructure and processes more environmentally friendly (SDG 13, 'Climate Action'; Dai & Menhas, 2020). In the field of sports tourism, several studies have shown that sports practice is the most important influencing factor for a more environmentally friendly behaviour of sports practitioners, which is especially true for nature-based activities (Mascarenhas, Pereira, Rosado, & Martins, 2021). However, it must also be emphasised that PA plays both a mitigating and an amplifying role in climate change. For example, transport related to sport practice is also a source of greenhouse gas emissions (Bernard et al., 2021).

A particular emphasis has been put on sports' and PA's educational potential to foster SD both directly and indirectly. Indirectly, sporting events can function as educational platforms for SD, as they can reach and inspire many people and, if staged appropriately, can also stimulate reflection on the cause of sustainability (Harris, 2013). Paradoxically, the controversies revolving around the latest FIFA Men's World Cup confirm this perspective as it provides a negative example where the educational potential of major sporting events for promoting SD was not unleashed.

In addition, an increasing number of researchers and political initiatives have conceived sport and PA as direct learning activities that can promote sustainable development and stimulate competencies for engaging with the cause of sustainability (Dai & Menhas, 2020; Nigg & Nigg, 2021). Against this background, sport and PA have also been suggested as a missing element of current Environmental and Sustainability Education (ESE) scholarship and practice, used here as an umbrella concept for various educational approaches dealing with ESE-related topics (e.g. climate change education, education for sustainable development (ESD),

Table 1 Search string formulas used for the systematic literature review

Educational context	Physical activity terms
Environmental and Sustainability Education	Sport*
Sustainability Education	Physical activit*
Environmental Education	Movement
Climate Change Education	
Education for Sustainable Development	

sustainability education) (Wals, Weakland & Corcoran, 2017). In this context, the potentials of physical education (PE) for ESE have also been pointed out several times (Baena-Morales & González-Víllora, 2022). As PE is a compulsory activity in the context of school, physical education is the only kind of sporting activity that reaches all children and young people.

The agenda of ESE has been forwarded as a means to empower individuals with the "knowledge, skills, values and attitudes to address the interconnected global challenges we are facing, including climate change, environmental degradation, loss of biodiversity, poverty and inequality" (UNESCO, n.d.). A common distinction of ESE practices has been between instrumental and emancipatory approaches (Jickling & Spork, 1998; Wals, 2012): Instrumental approaches, on the one hand, aim at changing learners' attitudes, values and behaviours in such a way that they directly contribute to SD. Emancipatory approaches, on the other hand, are intended to enable learners to make responsible and self-determined decisions in the context of sustainability and to participate in social decision-making processes as citizens. For the latter, forms of transformative and experiential learning have come to be considered pedagogical key enablers, as they go beyond theoretical knowledge acquisition and carry the potential to stimulate the intrapersonal and interpersonal skills and competencies needed to promote SD (Brundiers et al., 2021; Frank, 2021; Rieckmann, 2018; UNESCO, 2017).

Sport and PA may carry both instrumental and emancipatory potentials for ESE. In terms of the instrumental potential, several scholars have argued that these activities might directly promote sustainable behaviour (SuB), for instance, by exposing individuals to nature or stimulating social cohesion (Brymer, Downey, & Gray, 2009; Lohmann, Breithecker, Ohl, Gieß-Stüber, & Brandl-Bredenbeck, 2021; Collins & Brymer, 2020; Mascarenhas et al., 2021; Nigg & Nigg, 2021). Furthermore, their potential to improve learning processes (Bailey et al., 2009) and promote healthy lifestyles is well documented (Kuczala, Lengel, & Kuczala, 2010), making them potentially promising elements of sustainability-related learning more generally. Sport and PA have the emancipatory potential to foster skills and competencies needed for promoting the vision of sustainability, such as self-reflection, fair play, teamwork, empathy and cooperation (Orr, McCullough, & Pelcher, 2020). More generally, researchers have argued that sport and PA could be ideal enablers for transformative learning (Orr et al., 2020) and experiential learning (Newman, Alvarez, & Kim, 2017). It has been argued that these practices carry the capacity of "engaging the head, enacting the hands and enabling the heart" (Orr et al., 2020, p. 1076) through activities involving the head for critical reflection, the affective domain (i.e. the heart) for a relational knowledge to the world and the psychomotoric domain (i.e. the hands; Singleton, 2015; Sipos, Battisti, & Grimm, 2008).

In light of such claims, it is somewhat surprising that empirical research inquiring into the pedagogical potential of sport and PA to foster SD had remained scarce and scattered. In particular, the existing empirical results in the context of sport and ESE that have not yet been systematically synthesised and related to each other. Knowing about the various empirical findings is necessary, however, to make evidence-based suggestions as to how sport and PA can effectively contribute to the vision of sustainability and how they should be integrated in ESE contexts (Cury, Kennelly, & Howes, 2023). Against this background, this study sets out to provide the first systematic literature review of the current evidence on sport's and PA's potential for ESE.

Methods

The main goal of systematic literature reviews (SLR) does not only consist of synthesising the existing research on a topic (Harden, 2010) but also of enhancing the existing knowledge on a topic and integrating the findings. Furthermore, the rigour of the SLR is imposed by the specific rules, such as the criteria for including or excluding certain studies (Weed, 2005). The guideline followed in this work is set out in the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) (Page et al., 2021).

To find relevant scientific literature for this SLR, we conducted a database search for titles, abstracts, and keywords on Web of Science (WoS), SCOPUS and Education Resources Information Center (ERIC). We chose WoS and SCOPUS because they are two of the largest and most comprehensive databases for scientific peer-reviewed literature, and many literature reviews rely on these databases (Paul & Criado, 2020). ERIC is known as one of the most substantial databases for educational research.

The aim of our review was to identify research exploring the potential of sports/PA for ESE. *PA* was defined as "any bodily movement produced by skeletal muscles that results in energy expenditure" (Caspersen, Powell, & Christenson, 1985, p. 126). The term *sport* is to be considered the most comprehensive term for the search. A clear definition of the term is not possible; from the variety of different interpretations used in science and research, a wide range of search results was expected. In order to broaden the scope of our review, we also explicitly included the term *movement* in the search string. This also refers, for example, to mindfulness-based physical activities (e.g. Yoga, Qi-Gong) (Robert-McComb et al., 2015; Mattes, 2016). The search string formula is depicted in **Table 1**.

The database search was conducted on 2 May 2023, resulting in an initial sample of 1625 records. We only in-

cluded peer-reviewed, empirical journal articles published in English. Moreover, studies had to inquire into the potential of active sports/physical activity (in contrast to passively watching sports or attending sports events) for ESE. After applying these criteria and removing duplicates, we obtained an initial sample of 91 records for assessment. One article could not be found, seven articles were excluded because they were published in predatory journals (based on https://predatoryreports.org/), and 67 articles were excluded because on a closer look, they did not meet the eligibility criteria. The final sample thus consisted of 16 articles for in-depth analysis (**Fig. 1**). Each article was coded by two researchers. In case of ambiguity, a third researcher decided upon inclusion.

We analysed the identified studies based on the following research question: What are the defining characteristics of studies investigating the potential of sports and PA for ESE in terms of their research design and methods, type of sports/PAs and potential, target populations and the selection of journals?

Data analysis

After identifying the suitable articles for the SLR, a thematic content analysis (TCA) (Braun & Clarke, 2006) was conducted in order to extract the potential of sports/PA in the context of ESE from the remaining studies. We used inductive coding to generate our themes, given that the potential between sports/PA and ESE remains scarcely researched. Our analysis relied on semantic coding, that is, we sought to root our findings in the data that is explicated in the analysed studies without additional interpretation of this data. Coding was undertaken using MAXQDA (VERBI Software [2019], Berlin, Germany).

Findings

In this section, the findings of the SLR analysis are presented. In line with the research question *What are the specific characteristics of studies investigating the potential of sport and PA for ESE in terms of their research design and methods, populations examined and the selection of journals?*, this section is structured on three perspectives on these potentials as follows. First, the negative and no significant effects of sports and/or PAs in the context of ESE are presented. Second, the following subchapter presents the positive effects and hence potentials of sports and/or PAs for ESE together with their specific results and categories. Third, the general potential focuses on learning outcomes such as embodied/experiential/holistic learning. In this section, the impact of sports and/or PAs on ESE is demonstrated. This potential is shown through the different perspectives of ESE such as behavioural changes, especially those concerning environmental awareness and self-development for the personal realisation of individuals as well as the development of competences and skills.

When considering the chronological progression of the studies, the earliest research article dates back to over three decades ago (see e.g. Milner & Hancock, 1980), followed by a gap of almost two decades of the second identified study (see e.g. Thapa, Graefe & Meyer, 2005) and followed by regular publications over the years 2007, 2009, 2010, 2012 and 2016 (**Fig. 2**). During the 2019–2023 period, a total of nine articles were published. This equals over 50% of the studies dating to the past 4 years and indicating thus a positive development and growth of the research in this field.

When considering the type of practised sports and/or PAs, 9 out of 16 studies focused predominantly on outdoor sports and PAs. On the other hand, PE activities were researched on given studies, followed by the last two studies focusing on outdoor games, respectively. When looking closer at the specific types of activities, two articles focused on walking and bushwalking, two on camping, two on scuba diving, canoeing, rock climb-

Abstract

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Can learning to move foster sustainable development? A systematic literature review examining the potential of sport and physical activity in the context of environmental and sustainability education

Abstract

In order to move forward the agenda of sustainable development through Environmental and Sustainability Education (ESE), there is a need for learning activities that go beyond mere knowledge transmission. Characterised by their holistic and experiential nature, sport and physical activity may carry a potential of supporting and fostering the pedagogical purposes of ESE and thereby contribute to the vision of sustainable development. However, there has been little research on the relationship and synergy between sport and physical activity for ESE and no systematic literature review on this topic has been conducted yet. Against this background, the goal of this study is to inquire into the pedagogical potential of sport and physical activity with regard to the objectives of ESE based on the published empirical research. This study employs a systematic literature review approach followed by a thematic analysis. In all, 16 articles meeting the inclusion criteria were included in the review. The results suggest that sport and physical activity can contribute to ESE through their ability to promote (1) embodied, experiential and holistic learning, (2) positive effects in the context of prebehavioural factors and behavioural change(s) for more sustainable behaviour through increased environmental awareness and action, (3) learning-related effects on individuals defined by self-development and personal growth as well as social skills including cooperation and participation. On the other hand, some studies suggest that sport and physical activity might also cause negative or no significant effect at all. Overall, this study provides a first integrative overview on the pedagogical potential of sports and physical activity for ESE. Nevertheless, more research and conceptual clarity is needed to further specify this potential

Keywords

Competencies · ESE · Education for sustainable development · Climate change education · Nature conservation education

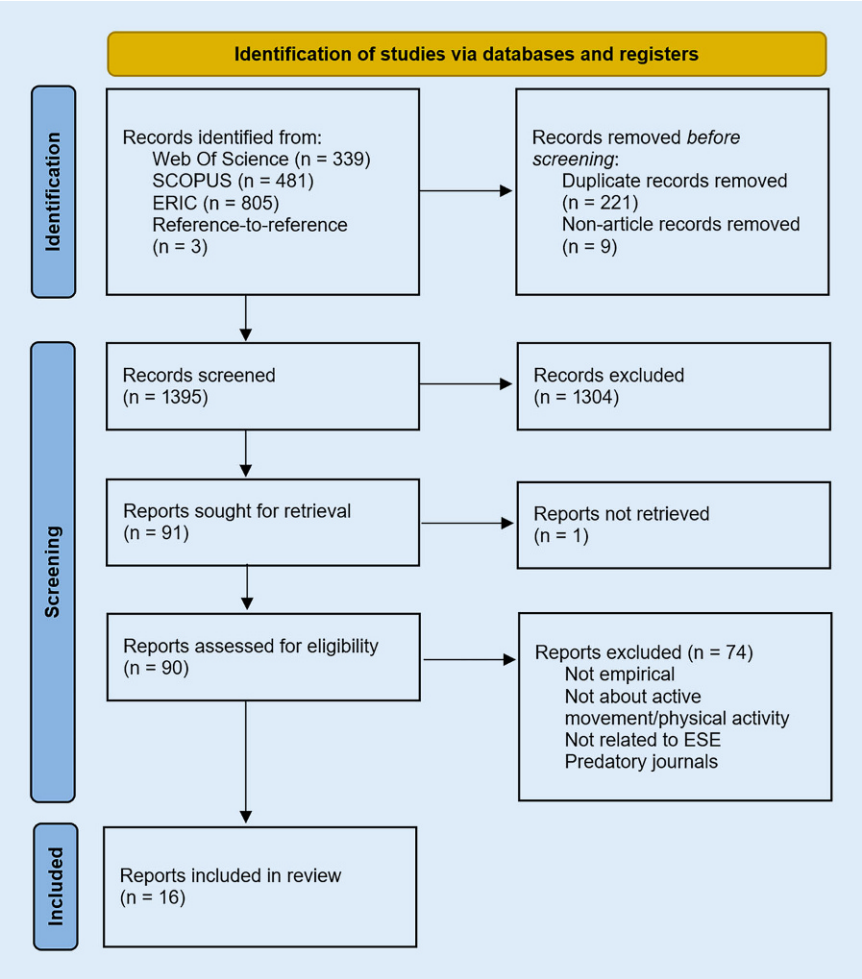

Fig. 1 ▲ PRISMA scheme for systematic literature review

ing, and more (◘ **Table 2**). It is worth mentioning here that some of the activities were more active than others (walking, fishing and photography versus competitive games and hiking); these were defined as appreciative activities by some authors. Finally, one study focused on *friluftsliv*, an activity defined by Lyngstad and Sæther (2021) as "outdoor recreation and it relates to moving and being moved in nature over a specified period of time, changing one's environment, having experiences of nature and respect for the nature and its' sustainable future" (p. 2).

Furthermore, a large number of the articles were published in educational journals such as *Journal of Environmental Education, Australian Journal of Environmental Education and Journal of Outdoor and Environmental Education* while only three articles were published in sports journals *such as Human Movement Journal* and the *Journal of Physical Education and Sport* (◘ **Table 2**). This shows the predominance of this topic being mainly researched in the context of ESE.

Concerning the research focus of the studies, the majority of the articles focused on essential aspects of ESE such as environmental behaviour and awareness (Fröberg et al., 2022; Jeronen et al., 2009; Potter, 2007; Riley Proctor, 2022), while others dedicated specifically to analysing the link between PE and environmental/sustainability competences (Baena-Morales et al., 2023; Mischenko et al., 2023), for example.

Potentials of sports and/or physical activities for embodied, experiential and holistic learning

Almost a third of the studies mentioned the concepts of embodied, experiential and holistic learning in relation to the sports–PAs–ESE relationship. For instance, Jeronen et al. (2009) examine the potential of PAs, nature trips and learning by doing for ESE. In their study, they describe that teachers of nature schools walking and orienteering in nature consider that learning by doing is essential in ESE, and that "it is important to use play and adventures, so that the pupils experience meaningful learning" (p. 17). Moreover, Couper and Porter (2016) who focused on the relationship between rock climbers and environmental awareness describe how a participant mentioned that "[t]his understanding [about the environment] through experiential learning is going to be invaluable to me …". Finally, Potter (2007), who explores the contribution of PAs at school for environmental learning describes how PAs such as planting native trees can "provide a focal point for environmental learning" (p. 16) and regards it as an important component of ESE since the children are provided with experiential learning through the three dimensions of the *head, heart* and *hands*. This direct experience may foster and motivate the development of environmental action.

Negative and no significant effects of sports and/or physical activities on environmental and sustainability education

In this subsection, the negative and no significant effects are described. Negative effects of sports and/or PAs for ESE are referred to those which negatively affect the individual practising the activity in the context of ESE (environmental behaviour and/or competences). In our review, an example of a negative result/potential was identified in Couper and Porter (2016) where a rock climber in the study claimed: "Although I had respect for nature, my motivations for climbing were extrinsic, it was a case of proving that I can beat nature's challenges, or conquer it, that was my sign of achievement; this thought pattern is in line with a classicist way of thinking, which is still apparent today…" (p. 8). This result was identified through the hedonistic values identified by Thapa et al. (2005), whose study re-

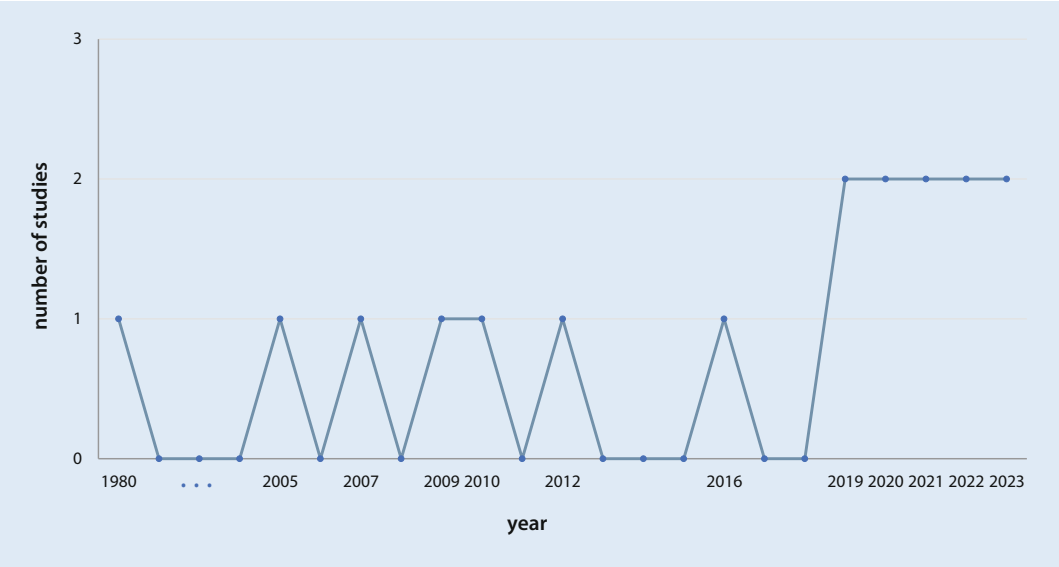

Fig. 2 ◀ Distribution of studies per year

searched the potential of scuba diving for environmental education and behaviour. More specifically, Thapa et al. (2005) focus on the evident consumption-oriented perspective "focus on hunting and collecting water trophies" (p. 64) of treasure hunters. At the same time, Couper and Porter (2016) mention the climbers' extrinsic motivation through "conquering nature or proving oneself in the face of nature's challenges" (p. 213) instead of an intrinsic persuasion of this activity.

No significant effects are referred to those which did not affect in any way the participants in the context of ESE. Hereby, 3 of the 16 studies reviewed showed that there was *no significant effect between sport/PA and ESE* (Osborne, 2012; Thapa, 2010; Thapa et al., 2005). More specifically, Thapa (2010) who looks at the relationship between participants of outdoor PAs in relation to their environmental behaviours states that the "influence of activity participation on attitude–behaviour correspondence was not significantly demonstrative" (p. 133). Furthermore, Osborne (2012) focused on the potential of PE for ESD through cooperative and competitive games. Nevertheless, a participant in his study stated that "physical education cannot by itself collaborate with Environmental Education and Education for Sustainable Development" (p. 283), especially due to the fact that the symbiosis between sport, PA and ESE is missing communication between stakeholders, partnerships and multidisciplinary work aligned with the pedagogical schools' goals.

Positive effects of sports and/or physical activities on environmental and sustainability education

The positive effects of the sports/PAs–ESE relationship are defined by those potentials which can foster the development of ESE from a beneficial perspective. This category includes three main categories of codes along with their subcodes. The first category contains results referring to prebehavioural factors and behavioural change(s), while the second one focuses on effects on the personal level of the participants such as self-development and self-realisation. Finally, the third category includes examples of positive effects for the development of competences and skills of sports and PA participants.

Effects on prebehavioural factors and behavioural changes(s) for sustainable behaviour

First, the behavioural dimension included *behavioural and prebehavioural factors and change(s) for SuB*. In this context, prebehavioural factors as well as behavioural changes for SuB and, therefore, ESE were defined as a set of determinants and changes that might (or might not necessarily) trigger SuB and possibly arise from the experience of the individuals from the practise of sport and/or PA. In total, these effects were mentioned a total of 71 times through the 16 articles.

When specifically analysing the *prebehavioural factors*, these included effects such as *environmental knowledge, environmental awareness and/or responsibility, strong connection with nature* and *emotional/affective/cognitive beliefs*, respectively. The *behavioural changes(s)* included *behaviour change in waste/mobility/resource-saving, consumer behaviour change* and *environmental action*.

Prebehavioural factors for sustainable behaviour

The prebehavioural factors for SuB included three main subcodes. First, *environmental knowledge* was reported in three studies (Fröberg et al., 2022; Thapa, 2010; Zafeiroudi, 2020). Examples reflecting this finding are shown by the experimental group in the study by Fröberg et al. (2022), who mentioned that the students "could generate information and knowledge for sustainable development during physical education lessons" (p. 8). In this study, the potential of PE for fostering sustainable competencies in PE teachers was explored.

Second, most of studies focused on *environmental awareness and/or responsibility* (Baena-Morales et al., 2023; Clark et al., 2020; Couper Porter, 2016; Fröberg

Table 2 Summary of the studies included in the systematic literature review

Order	Authors (year)	Research question	Type of sport/PA	Journal	Type of study	Method of data collection	Number and type of participants	Main findings
1	Milner and Hancock (1980)	What are the effects of physical activities on environmental competences and skills?	Camping, canoeing, backpacking, and skin and scuba diving	*Research in Education*	Quantitative	Pre- and posttest questionnaires in control and experimental groups	64 high-school students	PAs contributed to learning-related effects for self-growth such as the cultivation of positive values and experiences for self-growth but also social skills such as cooperation and community connectedness and participation
2	Thapa et al. (2005)	The influence of scuba diving on the relationship between marine-based environmental knowledge and behaviour	Scuba diving and dive-related activities (underwater photography)	*Environmental Education*	Quantitative	Statistical analysis	370 scuba divers	Scuba divers showed increased environmental knowledge, awareness and also changes in their consumer behaviours Nevertheless, some of them showed negative effects such as an extrinsic motivation for hunting and collecting marine trophies and others were not aware of the functioning of coral reefs despite practising scuba-diving
3	Potter (2007)	How do physical activities at school contribute to environmental learning?	Yoga, tree planting, creek exploring	*Australian Journal of Environmental Education*	Empirical, qualitative	Observations of school documents (curriculum materials, newsletters)	–	PAs at school provide the opportunities for experiential learning but also cultivate prebehavioural factors for SuB such as environmental awareness and social skills such as participation in school students
4	Jeronen, Jeronen, and Raustia (2009)	How do physical activities, nature trips and learning by doing in nature contribute to environmental education?	Games, playing, nature trips	*International Journal of Environmental Science Education*	Qualitative	Questionnaire surveys	23 nature school teachers	The impact of PAs in nature schools was not very strong mainly due to the fact that students were not practising them on a regular basis Nevertheless, it was shown that the activities increased environmental knowledge and contributed to experiential learning, to a limited extent
5	Thapa (2010)	What is the relationship between outdoor recreational activities and environmental attitude-behaviour?	Appreciative activities (bird-watching, walking, swimming, canoeing, etc.), consumptive activities (hunting, fishing, etc.) and motorised activities (snowmobiling)	*Environmental Education*	Quantitative	Questionnaire surveys	522 correspondents practising outdoor recreational activities in forests	PAs did not significantly influence the environmental attitude-behaviour of participants but it had some positive effects on environmental attitudes and behaviours and consumer behaviour change
6	Osborne (2012)	How can physical education at the local level contribute to the goal of ESD?	Cooperative and competitive games	*Human Movement*	Empirical, qualitative	Interviews, observations and document analysis	16 professionals from seven public schools and three administrative buildings	PE leads to positive effects for both pre- and behavioural factors and changes such as environmental awareness and action Learning-related results are based on self-development and growth such as the cultivation of positive values but also social skills including cooperation, volunteering and participation

Table 2 (Continued)

Order	Authors (year)	Research question	Type of sport/PA	Journal	Type of study	Method of data collection	Number and type of participants	Main findings
7	Couper and Porter (2016)	How can the experiences of rock climbing practitioners increase environmental awareness?	Module consisting of ten sessions of outdoor rock climbing	*Geography in Higher Education*	Qualitative	Analysis of written assessments after having finalised the module	Eight students	Rock climbing fostered prebehavioural factors for SuB such as a strong connection with nature and environmental awareness especially Moreover, it also provided room for reflection and increased the climbers' confidence by providing a positive attitude about the activity itself
8	Floresca (2019)	What is the impact of a nature walk on environmental behaviours and nature awareness?	A physical education course including nature walks, mountain/trail hiking or trekking, outdoor camping and nature survival activities and bird watching afterwards	*Education Quarterly Reviews*	Qualitative	Questionnaire survey	70 student participants	Walking contributed to fostering environmental awareness, a sustainable use of resources and affective beliefs concerning the environment Furthermore, it also contributed to self-growth and development by inducing feelings of happiness and self-worth Finally, it also promoted cooperation and bonding within the team
9	Clark, Maples, and Sharp (2020)	What is the relationship between a climbers Leave No Trace program and the practitioners' level of environmental awareness?	Rock climbing	*Outdoor and Environmental Education*	Quantitative	Surveys	Data collection from climbing organisations (between 5000 and 7500 climbers)	The Leave No Trace program for rock climbers contributed to positive effects such as an increased environmental awareness and behaviour change in the context of correct waste recycling
10	Zafeiroudi (2020)	Can outdoor recreation activities influence the information perceptions of environmental issues; environmental, cognitive and affective beliefs; predisposition for environmental action; and environmentally responsible behaviour?	Trekking, mountain biking, orienteering, archery, ropes courses, canoeing, rock climbing, night hiking	*Academic Journal of Interdisciplinary Studies*	Quantitative	Pre- and posttest questionnaires	262 secondary school and high school students	Findings were statistically significant and show that outdoor recreation activities foster positive effects for prebehavioural factors such as environmental knowledge and awareness but also behavioural changes such as environmental action Second, they also foster social skills such as the ability to motivate others
11	Blades (2021)	What is the effect and meaning of walking as embodied encounters with/in nature and therefore, on environmental education?	Walking, bushwalking	*Journal of Outdoor and Environmental Education*	Qualitative	Summary of direct experiences, memory of experiences and, reflections of experiences	Outdoor education students (exact number is not specified)	Walking contributes to embodied learning and increases the connection to nature Furthermore, it also provides further positive effects by increasing the attention and awareness and leading thus to self-growth

Table 2 (Continued)

Order	Authors (year)	Research question	Type of sport/PA	Journal	Type of study	Method of data collection	Number and type of participants	Main findings
12	Lyngstad and Sæther (2021)	How can friluftsliv contribute and relate more to education for an environmentally sustainable future and the earth locally and globally	Physical education combined with friluftsliv outdoor activities such as kayaking and climbing	*Sport, Education and Society*	Qualitative	Questionnaire	37 students of secondary upper school	Friluftsliv contributes to ESE by enhancing social skills by motivating students to cooperate, collaborate and act in solidarity with others Furthermore, it fosters volunteering and participation during the friluftsliv trips Secondly, it cultivates meaningful experiences where individuals can develop and contributes thus to self-growth, self-esteem and confidence Third, it also contributes to environmental awareness and experiential learning
13	Baena-Morales, Urrea-Solano, Gavilán-Martin, and Ferriz-Valero (2023)	Which are the competences associated with sustainability in the context of physical education?	Physical activity and sport sciences students	*Journal of Applied Research in Higher Education*	Quantitative	Questionnaire	341 students of physical activity and sport sciences with experience in sports	The students involved in the study scored higher for social skills including equal opportunities and the reduction of inequalities in PE classes Furthermore, they also showed a high awareness and responsibility for the environment and sustainability
14	Fröberg, Wiklander, and Lundvall (2022)	How does physical education contribute to the development of sustainable competencies in physical education teachers?	Physical education teachers practising organised sports, exercise, outdoor life, and dance	*International Journal of Environmental Research and Public Health*	Quantitative	Online questionnaires	1153 participants (teachers of physical education and health)	PE actively contributed to behavioural changes for SuB by motivating participants to environmental actions such as reducing polluting waste and using resources more efficiently. Furthermore, it also fosters social skills in the context of social sustainability (gender inequality during PE classes, recognition of local culture and local products and equal opportunities)
15	Riley and Proctor (2022)	How can physical education generate a sense of belonging within the environmental education nexus?	Skiing	*Australian Journal of Environmental Education*	Qualitative	Vignettes and introspection analysis of physical education classes with fourth and seventh grade students	Not mentioned in the study	PE contributed to experiential and embodied learning as well as the learning-related effects for self-growth such as reflection and self-confidence Furthermore, it also fostered social skills such as a sense of belonging
16	Mischenko et al. (2023)	How does physical education contribute to the development of environmental competences?	Physical education excursions, environmental games and hikes, collective work outdoors, relay races and sports games	*Journal of Physical Education and Sport*	Quantitative	Pre- and posttest questionnaires in control and experimental groups	44 secondary school students	The results of the study encompassed positive effects as well as learning-related outcomes. First, the study reported positive effects for environmental motivation and environmental knowledge Moreover, participants showed and increased emotional and affective attitude for the environment

et al., 2022; Jeronen et al., 2009; Floresca, 2019; Milner Hancock, 1980; Lyngstad Sæther, 2021; Osborne, 2012; Thapa, 2010; Thapa et al., 2005; Zafeiroudi, 2020). An interesting finding is that of Thapa (2010), who found out that "outdoor recreation participation did mediate the relationship between environmental attitudes and behaviours for only appreciative and motorised recreationists" (p. 146). This result was also reported in Baena-Morales et al. (2023), whose study explored whether and which competences in PE are associated with sustainability. The results of the study were positive, and outdoor PE activities increased environmental awareness. Finally, Osborne (2012) described how students took walks in the neighbourhood "to become aware of environmental problems such as garbage disposal and sewage treatment" (p. 283).

Third, a *strong connection with nature* resulting from the sports/PAs–ESE relationship was also identified in Blades (2021), Couper and Porter (2016) and Floresca (2019). Blades (2021) examined the activity of walking in the context of environmental education and embodied learning. In this study, the author specifically mentions that bushwalking feels as a "vibrant walking ecopedagogy with/in nature" (p. 314). Similarly, a participant in the study by Couper and Porter (2016) describes that the "challenge of rock climbing has been a spiritual epiphany for me with a strong connection with the environment and excellent partnerships being formed" (p. 8).

Fourth and with regard to the subcategory of *emotional/affective/cognitive changes*, findings were drawn from two studies (Lyngstad Sæther, 2021; Mischenko et al., 2023). For example, Lyngstad and Sæther (2021) find that friluftsliv trips led to a positive and emotional experience on the students: "the class worked so well together! Particularly when we built a campfire one of the last days of the trip. We were sitting around the campfire in the middle of the mountains. When it got dark, we saw the greatest and most beautiful northern lights ever. These are some of the best things I have experienced" (p. 520). Furthermore, Mischenko et al. (2023) explore the contribution of PE for the environmental competences of school students. As a result, the authors find that both cognitive (2.7 times greater) and emotional (2.3 times greater) criteria of environmental competence of students from the experimental group—physical exercises with limitation of ecological behaviour at home and outdoors—increased more than for the control group. In these terms, the cognitive criterion is defined through interest in environmental problems while the emotional criterion is characterised as an appreciation of the value that nature has for humankind.

Behavioural change(s) for sustainable behaviour

Regarded as a positive effect for fostering ESE, behavioural change(s) for SuB were present in over half of the reviewed studies and contained themes such as *environmental action, consumer behaviour* and *behaviour change in waste/mobility/resource-saving* and *volunteering and/or participation*. In this review, behavioural changes are defined as individuals' positive changes in areas involving sustainable decision-making and thinking-processes as a possible result of the practise of sport and/or PA.

First, *environmental action* was reported by Fröberg et al. (2022), Osborne (2012) and Zafeiroudi (2020). For example, Zafeiroudi (2020) examined the potential of outdoor activities practised by school students for different aspects of environmental education such as environmental, cognitive and affective beliefs and behaviours. In the study, Zafeiroudi (2020) observed that engaging in outdoor activities (e.g. hiking, canoeing) influenced the participants' affective attributes towards environmental action (e.g. happiness when others try to save energy) and "comparison of the two groups might lead one to conclude that the intervention program had a significant impact with respect to influencing the participants to take action on environmental issues" (p. 53). Here, the author concludes that the post-intervention group influenced the participants in a positive way for taking actions on environmental challenges. Furthermore, Fröberg et al. (2022) who investigated the potential of PE for sustainable competencies in PE teachers noted that actions for "mitigating climate change" could be developed through PE activities (p. 8).

Second, *consumer behaviour* was identified in Fröberg et al. (2022), Thapa (2010) and Thapa et al. (2005). More specifically, green consumer behaviours were significant in participants practising appreciative physical activities such as day walking/hiking, swimming and mountain biking among others (Thapa, 2010).

Third, *behaviour change in waste/mobility/resource-saving* was reported in Clark et al. (2020), Fröberg et al. (2022), Osborne (2012) and Zafeiroudi (2020). The study by Clark et al. (2020) explored whether and how a 'Leave No Trace' program influenced rock climbers for being environmentally more sustainable and reported that participants were more aware of the issue of waste and "discarded biodegradable waste (like apple cores) in the backcountry" (p. 79).

Finally, *volunteering and/or participation* was identified in Lyngstad and Sæther (2021), Milner and Hancock (1980) and Osborne (2012). In their study, Lyngstad and Sæther (2021) focus on friluftsliv as an ideal moving medium for fostering education in school students for the environment and having experiences in nature. As a result, the authors state the following: "they [the school students] appear to have been a part of an interactive culture in school, and their responses reveal a focus on *team-work, cooperation, understanding others*, and *helping each other* when on trips" (p. 521). A similar result can be found in the study by Milner and Hancock (1980) who assessed the effects of PAs on the environmental competences and skills of high-school students. Here, the authors report beneficial effects as well: "the growth in Group Differences is apparently a result of participation in the group activities—the sharing of responsibilities and the working together in the physical education activities" (Milner Hancock, 1980, pp. 7–8).

Learning-related effects

Development of the self and personal skills

A major percentage of the studies in this review included self-development and personal growth as a result of the sports and/or PAs–ESE relationship. Categorised as a positive effect, self-development and growth are defined through beneficial changes at the personal level of individuals, not from the environmental perspective but from that of self-realisation and self-development, which are also necessary for ESE (both at an individual and societal level). Furthermore, self-development and growth are different from competences in the sense that they are more of a mindset and a self-concept than something acquired consciously and intentionally or on purpose.

The effects of this category include *confidence and/or positive image about oneself, cultivation of positive values and experiences, increase in attention/experience/happiness, sense of responsibility* and ultimately, *reflection*.

First, a total of 4 studies (Couper Porter, 2016; Floresca, 2019; Lyngstad Sæther, 2021; Riley Proctor, 2022) found out that *confidence and/or positive image about oneself* improved with the practice of sports and PAs. Second, this review also identified studies stressing particularly the importance of *the cultivation of positive values and experiences for self-growth* (Lyngstad Sæther, 2021; Mischenko et al., 2023; Zafeiroudi, 2020). For this result, Lyngstad and Sæther (2021) describe how friluftsliv trips emotionally impacted the participants such that they trust each other. The findings of Osborne (2012) provide further insights into the cultivation of positive values, where interviewees of PE mentioned that students "developed dance activities that work with the environment theme" (p. 283) and that PE seemed to cultivate behaviours and values such as the acceptance of rules and contribute to interpersonal relationships inside and outside of the school.

In terms of the subcategory *increase in attention/experience/happiness*, Blades (2021) highlights that attentiveness is supported by walking with/in natureScapes (p. 312). Floresca (2019) examines similarly to Blades (2021) the impact of nature walking on environmental behaviours and awareness and demonstrates in the context of the Nature Walk Program that spotting or seeing birds, regardless of their species, leads to ecstasy, happiness, and fulfilment. Participants of this study also describe that the program helps them forget their worries and relax at night (mental health).

Furthermore, *sense of responsibility* was identified in the study by Riley and Proctor (2022), who focused on outdoor PE classes with reference to environmental education and state that "outdoor learning provided a platform for these students to take on leadership roles within the learning project" (p. 273). This finding was also reported by Milner and Hancock (1980), whose findings highlighted that students of PE "were encouraged by their experience to assume the responsibility to work within a group structure to improve the quality of life and their environment" (p. 7).

As for *reflection*, Lyngstad and Sæther (2021) state that participants "reflect on what one's own contributions and efforts mean for the development of each student and the group on a trip. The students' narratives reflect that they have experienced that their personal contribution and co-responsibility in friluftsliv are the grounds for both good and bad group processes" (p. 521). Moreover, "[t]heir responses show that they reflect on experiences from the friluftsliv trips, that they have learnt very many things and intend to use the competence they have acquired in their lives" (ibid., p. 522).

Development of social skills

Research on ESE has not only revolved around the behavioural dimensions of learning for making conscious decisions with respect to sustainability. The research also highlights the importance of acquired competences and skills as tools for sustainable decision-making processes encompassing the socioemotional and cognitive dimensions of learning. Here, attention to how sport and PA promote the acquisition of competences will also be drawn. Within this review, *the development of competences and/or skills* is defined as explicitly targeted learning goals and outcomes that the individuals can acquire consciously and willingly (ability to motivate others) and that are at the same time actively promoted and applied in educational or non-educational settings. Contrary to prebehavioural factors, which can be regarded as predictors and/or determinants for SuB, competences are necessary resources for the development of SuB, not just determinants or complements.

Characterised as a positive effect, the development of competences and skills included the main aspect of the *development of social abilities*, without a direct environmental relation such as environmental action or environmental awareness (see the section below).

Development of social competences

The development of social competences focusing on factors which have a social component and could foster ESE contained further aspects such as the *development of the social sustainability dimension, motivating others, sense of belonging, community connectedness, group bonding and empathy* and *cooperation*.

First, the effects consisting of the *development of the social sustainability dimension* were mentioned often by Baena-Morales et al. (2023) and Fröberg et al. (2022). Examples of these findings are revealed in Baena-Morales et al. (2023) through a post-intervention questionnaire which recorded a "high score for equal opportunities or reducing inequalities during physical education lessons" and "[o]ne of the main findings of this work is the possible relationship between students' competitive sports experience and better performance in the social dimension of SD" (pp. 9–10). Examples derived from the study by Fröberg et al. (2022) are the following, where participants of PE reported the potential of PE for ESE: "I could use physical education to contribute to reducing the use of harmful substances in young people", "I could make physical education lessons accessible to everyone regardless of gender, race, or personal situation",

"I could reduce gender inequality in physical education lessons", and "I could contribute to promoting equality for vulnerable people in physical education sessions" (p. 8).

Second, these effects are also discernible from *motivating others*, an aspect identified in the study by Zafeiroudi (2020), where the predisposition for encouraging others was statistically significant in the experimental group with respect to the control group, meaning that sport and PA affected this factor. More importantly, this predisposition denoted the fact that the individuals in the experimental groups may have supported others concerning the solving of environmental issues.

Third, a *sense of belonging* was identified in Milner and Hancock (1980) but also Riley and Proctor (2022), who specify that "children and youth have opportunities to cultivate a sense of belonging in, and through, physical activity" (p. 274).

Fourth, the result of *community connectedness, group bonding and empathy* was identified in almost a third of the studies (Baena-Morales et al., 2023; Floresca, 2019; Lyngstad Sæther, 2021; Milner Hancock, 1980; Riley Proctor, 2022). This finding is especially emphasised by Lyngstad and Sæther (2021), who state that the experiences arising from outdoor activities "took in an atmosphere of *solidarity, teamwork*, and *collaboration*" (p. 521) but also that "[t]he analysis indicates that there is little focus on achievements and competition in the students' writings about friluftsliv, rather the attention is on a sense of togetherness and experiencing nature together with others" (p. 523). Another perspective is that of the study by Floresca (2019) who focused on appreciative activities such as bird watching, which "involved group effort hence promoting teamwork and a closer relationship between the participants. It was brought about by being together when they search for birds during their free time, wherein these activities served as their *group bonding*[1] moments" (p. 161). Finally, one last finding worth mentioning is that of Milner and Hancock (1980) who describe that "[t]he active involvement of the participants in team efforts such as camping, canoeing, and skin and scuba diving had a tendency to enhance interactions among students" (p. 1).

Cooperation was also identified in 4 studies (Baena-Morales et al., 2023; Lyngstad Sæther, 2021; Milner Hancock, 1980; Osborne, 2012). In their study, Baena-Morales et al. (2023) describe that PE classes contribute to developing cooperative relationships and socialisation, while friluftsliv provided an opportunity for experiencing close relationships in challenging situations (Lyngstad Sæther, 2021). Finally, Osborne (2012) mentioned that PE promotes cooperative behaviour and socialisation by providing "a sense of commitment between members of different generations" (p. 285), particularly cooperative PE games, which "cultivate the idea that the students will have more success through cooperation rather than competition, and that this new attitude would contribute to a more just and fraternal society" (p. 282).

Discussion

This literature review set out to inquire into the pedagogical potential of sport and PA with regard to the objectives of ESE based on the existing empirical literature. Our first and perhaps most important result—confirming results of previous reviews (Cury et al., 2023; Mascarenhas et al., 2021)—is that the relation between active sport/PA and ESE remains scarcely researched to date. We identified only 16 published articles empirically inquiring into the potential of sports/PA for ESE. Moreover, the identified body of literature was highly scattered with regard to the kind of physical activity the articles focused on, their methodological approaches and their conceptualizations of sustainability-related outcomes when engaging with sport and PA. This heterogeneity makes it difficult to make any general statement, let alone a conclusive one, with regard to sport's and PA's potential for ESE.

This limitation in mind, the analysed articles provide some first insights into the potential of sport and PA for ESE.

Overall, the majority of studies indicate a positive potential of sports/PA for the purposes of ESE. Sports/PA are often considered here as activities that allow learners to engage in experiential and embodied forms of learning, which have been repeatedly described as a key pedagogical approach within sustainability-related learning (e.g. UNESCO, 2017). More specifically, we distinguished two types of potential sports/PA carry for ESE, namely (1) effects on prebehavioural factors and behavioural changes related to sustainability, and (2) learning-related effects, which we further divided into personal and social skill acquisition. These effects correspond to the distinction of instrumental and emancipatory purposes of ESE.

Concerning its instrumental potential (in the sense of stimulating sustainability-oriented behaviour), our studies were in line with those from Mascarenhas et al. (2021), indicating that practising (especially outdoor) sports can lead to more sustainability-oriented behaviours. They can also indirectly contribute to such behaviours by increasing environmental knowledge, awareness and a sense of responsibility for one's environment. Practising sports/PA outside might also enhance one's connectedness to nature, potentially strengthening sustainability-related behaviour, too (Blades, 2021; Couper Porter, 2016; Floresca, 2019). This said, it must be taken into account that the analysed studies often refer to short-term interventions. Consequently, it is both unclear whether the observed effects persisted in the long term and how long-term interventions might affect prebehavioral factors and sustainability-related behaviours, corroborating the need for future research in this field (Cury et al., 2023).

Concerning its emancipatory potential (in the sense of enabling learners to make self-determined decisions), we found that practising sport and PA can contribute to the development of certain skills that are increasingly construed as important learning outcomes of ESE. For one, these comprise intrapersonal skills,

[1] Colloquial term for spending time together to create a deeper relationship.

such as a positive self-image, a sense of ownership and responsibility, or reflection abilities, strongly overlapping with intrapersonal sustainability competencies or related concepts (Brundiers et al., 2021; Frank, 2021; Inner Development Goals, 2021; Libertson, 2023). For another, they encompass social skills, such as the ability to motivate others, empathy, or cooperation, skills that are associated with so-called interpersonal sustainability competencies (Brundiers et al., 2021; Inner Development Goals, 2021; Henkel et al., 2023). Practising sport and PA might thus carry a direct educational potential for enabling learners to engage with the cause of sustainability in a constructive and self-determined way by building intra- and interpersonal competencies. Future research should further inquire into this potential by more explicitly applying existing competency frameworks.

Notwithstanding these results, our findings also indicate that sport and PA do not seem to carry a positive potential with regard to the pedagogical aims of ESE per se. A couple of studies found no effect of practising sports/PAs or even indicated undesirable effects on practitioners (Couper Porter, 2016; Thapa et al., 2005; Thapa, 2010). Consequently, future research should look more closely at the specific conditions (e.g. which type of sports, in which environment, for whom) allowing sport and PA to unfold its potentials for ESE.

In sum, despite the limited amount of existing empirical evidence and the conceptual and methodological vagueness describing the existing studies in the field, the presented results indicate a potential of sport and PA for ESE that is worth being further explored. This is all the more so in light of sport's and PA's undisputed potential to maintain and improve mental and physical health and support learning activities. In this sense, sport and PA might carry a synergistic potential for ESE by simultaneously improving learning processes, promoting individual learning and stimulating specific sustainability-related learning outcomes. In order to inquire into this synergistic potential, future research could look at such practices embedded in or intertwined with rather traditional ESE learning activities (e.g. discussing theoretical content while walking). In a similar vein, ESE scholars might think about and inquire into ways to integrate evidence from sport and movement sciences to promote learners' health and improve learning processes, for example, by teaching and inviting learners to take different postures and frequently change sedentary postures in ways that do not involve sitting on a chair (Raichlen et al., 2020).

Limitations

Several limitations come along with our study. First, our search strategy restricted the publications we could identify within our literature review. We limited our search to the databases SCOPUS, ERIC, and Web of Science. While these include the most comprehensible scientific databases concerning our research interest, more studies might have been found by including sports-related databases (e.g. SportDiscuss). More studies might have been found by including non-peer-reviewed publications (e.g. Masters' and PhD dissertations) or studies published in other languages.

Second, our search string may have excluded articles related to our research interest. Researchers looking at the potential of sport and PA for ESE might not refer to educational contexts, but rather speak of attitude change, raising awareness, behaviour change or other terms specifying potential effects resulting from performing these activities. The search string further limited the results by not including specific types of sport and PA (e.g. climbing, running, canoeing, handcraft), although studies might use these more explicit instead of generic terms. At the same time, sport, PA and movement practice is highly diverse, so that listing single types of such activities would necessarily exclude other forms of sport, PA and movement.

Conclusion

This study set out to provide the first systematic literature review of the current evidence on sport's and physical activity's (PA's) potential for environmental and sustainability education (ESE). In all, 16 peer-reviewed journal articles were identified that empirically inquired into this potential. While our results provide a new and comprehensive understanding of this underresearched topic, it seems that sport and PA can foster ESE in terms of learning-related outcomes including self-development and personal growth as well as social skills and positive effects in the context of prebehavioural factors and behavioural change(s) for the environment. All these factors are supported by the dimension of experiential and embodied learning that sports and PAs offer. In particular, the potential of sport and PA was emphasised in two main terms: (1) positive effects through the promotion of pre- and behavioural aspects of ESE and sustainable behaviour (SuB) such as a strong connectedness with nature, environmental action and awareness and consumer behaviour but also (2) learning-related outcomes in terms of social skills and self-growth and development such as reflection but also a positive image about oneself.

At the same time, both direct and indirect potentials can be recognised, especially while considering the type and context of sport and/or PA. While our study shows that sport and PA can foster ESE, this does not mean that these learnings and acquired competences will translate directly into SuB. Instead, further aspects such as reflection and introspection are necessary. Through their holistic dimension, sport and PA can motivate individuals to act for sustainability. Finally, future research is needed in order to understand how this potential can be enhanced and be better integrated on a practical level in the future.

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Declarations

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References

Baena-Morales, S., González-Víllora, S. (2022). Physical education for sustainable development goals: reflections and comments for contribution in the educational framework. *Sport, Education and Society*. https://doi.org/10.1080/13573322.2022.2045483.

Baena-Morales, S., Urrea-Solano, M., Gavilán-Martin, D., Ferriz-Valero, A. (2023). Development and validation of an instrument to assess the level of sustainable competencies in future physical education teachers. PESD-FT questionnaire. *Journal of Applied Research in Higher Education*, *15*(1), 1–19. https://doi.org/10.1108/JARHE-09-2021-0330.

Bailey, R., Armour, K., Kirk, D., Jess, M., Pickup, I., Sandford, R., Education, B. P. (2009). The educational benefits claimed for physical education and school sport: an academic review. *Research papers in education*, *24*(1), 1–27. https://doi.org/10.1080/02671520701809817.

Bernard, P., Chevance, G., Kingsbury, C., Baillot, A., Romain, A.-J., Molinier, V., Gadais, T., Dancause, K. N. (2021). Climate change, physical activity and sport: a systematic review. *Sports Medicine*, *51*, 1041–1059. https://doi.org/10.1007/s40279-021-01439-4.

Blades, G. (2021). Making meanings of walking with/in nature: embodied encounters in environmental outdoor education. *Journal of Outdoor and Environmental Education*, *24*(3), 293–318. https://doi.org/10.1007/s42322-021-00087-6.

Braun, V., Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa.

Brundiers, K., Barth, M., Cebrián, G., Cohen, M., Diaz, L., Doucette-Remington, S., Dripps, W., Habron, G., Harré, N., Jarchow, M., Losch, K., Michel, J., Mochizuki, Y., Rieckmann, M., Parnell, R., Walker, P., Zint, M. (2021). Key competencies in sustainability in higher education—toward an agreed-upon reference framework. *Sustainability Science*, *16*(1), 13–29. https://doi.org/10.1007/s11625-020-00838-2.

Brymer, E., Downey, G., Gray, T. (2009). Extreme sports as a precursor to environmental sustainability. *Journal of Sport Tourism*, *14*(2–3), 193–204. https://doi.org/10.1080/14775080902965223.

Caspersen, C. J., Powell, K. E., Christenson, G. M. (1985). Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public health reports*, *100*(2), 126.

Clark, B. G., Maples, J. N., Sharp, R. L. (2020). Awareness and application of minimum impact practices among rock climbers in the Red River Gorge, Kentucky. *Journal of Outdoor and Environmental Education*, *23*, 73–86. https://doi.org/10.1007/s42322-019-00048-0.

Collins, L., Brymer, E. (2020). Understanding nature sports: a participant centred perspective and its implications for the design and facilitating of learning and performance. *Annals of Leisure Research*, *23*(1), 110–125. https://doi.org/10.1080/11745398.2018.1525302.

Couper, P., Porter, S. (2016). "Environmental awareness" and rock climbing: changing pedagogies to enhance pro-environmental graduate attributes. *Journal of Geography in Higher Education*, *40*(2), 207–221. https://doi.org/10.1080/03098265.2016.1141187.

Cury, R., Kennelly, M., Howes, M. (2023). Environmental sustainability in sport: a systematic literature review. *European Sport Management Quarterly*, *23*(1), 13–37. https://doi.org/10.1080/16184742.2022.2126511.

Dai, J., Menhas, R. (2020). Sustainable development goals, sports and physical activity: the localization of health-related sustainable development goals through sports in China: a narrative review. *Risk Management and Healthcare Policy*, *13*, 1419–1430. https://doi.org/10.2147/RMHP.S257844.

Eßig, N. (2018). Zukunftsfähige Sportinfrastruktur – hilft uns hier die Nachhaltigkeit weiter? In N. Eßig, R. Kähler, M. Palmen C. Deuß (Eds.), *Nachhaltigkeit und Innovationen von Sportstätten und -räumen* (pp. 17–28). Bonn: Deutsche Vereinigung für Sportwissenschaft.

Floresca, J. A. (2019). Nature walk program as means of reconnecting with the natural environment: an alternative physical education. *Education Quarterly Reviews*, *2*(1), 155–163. https://doi.org/10.31014/aior.1993.02.01.48.

Frank, P. (2021). A proposal of personal competencies for sustainable consumption. *International Journal of Sustainability in Higher Education*, *22*(6), 1225–1245. https://doi.org/10.1108/IJSHE-01-2020-0027.

Fröberg, A., Wiklander, P., Lundvall, S. (2022). Sustainable development competencies among more than 1100 certified physical education and health teachers in Sweden. *International Journal of Environmental Research and Public Health*, *19*(23), 15914. https://doi.org/10.3390/ijerph192315914.

Gadais, T., Decarpentrie, L., Charland, P., Arvisais, O., Paquito, B. (2022). Health and education through sport for development and peace in extreme development contexts: cases studies from various developing countries. In C. Sobry K. Hozhabri (Eds.), *International perspectives on sport for sustainable development* (pp. 95–113). Basel: Springer. https://doi.org/10.1007/978-3-031-06936-9_5.

Greve, S., Süßenbach, J. (2022). 'Save the queen': female national wheelchair basketball players in gender-segregated and gender-mixed competitive sport. *German Journal of Exercise and Sport Research*, *52*(4), 666–672. https://doi.org/10.1007/s12662-021-00791-x.

Harden, A. (2010). Mixed-methods systematic reviews: integrating quantitative and qualitative findings. *Focus*, *25*, 1–8.

Harris, R. (2013). An exploration of the relationship between large-scale sporting events and education for sustainable development: the case of the Melbourne 2006 commonwealth games. *The International Journal of the History of Sport*, *30*(17), 2069–2097. https://doi.org/10.1080/09523367.2013.845173.

Heckemeyer, K. (2018). *Leistungsklassen und Geschlechtertests: Die heteronormative Logik des Sports* (1st edn.). Bielefeld: transcript. https://doi.org/10.14361/9783839442166.

Henkel, G., Singer-Brodowski, M., Reith, A., Frank, P., Rieckmann, M. (2023). What is needed to act as a professional change agent for sustainability? A systematic literature review. International Review of Education. *Journal of Lifelong Learning.*

Inner Development Goals (2021). Inner development goals: background, method and the IDG framework. https://www.innerdevelopmentgoals.org/s/211201_IDG_Report_Full.pdf

Jeronen, E., Jeronen, J., Raustia, H. (2009). Environmental education in Finland—a case study of environmental education in nature schools. *International Journal of Environmental and Science Education*, *4*(1), 1–23.

Jickling, B., Spork, H. (1998). Education for the environment: a critique. *Environmental Education Research*, *4*(3), 309–327.

Kuczala, M., Lengel, T., Kuczala, M. (2010). *The kinesthetic classroom: teaching and learning through movement*. Thousand Oaks: Corwin.

Libertson, F. (2023). Inner transitions in higher education in Sweden: Incorporating intra-personal skills in education for sustainable development. *International Journal of Sustainability in Higher Education*, *24*(9), 213–230. https://doi.org/10.1108/IJSHE-12-2022-0395.

Lindsey, I., Chapman, T. (2017). *Enhancing the contribution of sport to the sustainable development goals*. London: Commonwealth Secretariat.

Lohmann, J., Breithecker, J., Ohl, U., Gieß-Stüber, P., Brandl-Bredenbeck, H. P. (2021). Teachers' professional action competence in education for sustainable development: a systematic review from the perspective of physical education. *Sustainability*, *13*(23), 13343. https://doi.org/10.3390/su132313343.

Lyngstad, I., Sæther, E. (2021). The concept of 'friluftsliv literacy' in relation to physical literacy in physical education pedagogies. *Sport, education and society*, *26*(5), 514–526. https://doi.org/10.1080/13573322.2020.1762073.

Mascarenhas, M., Pereira, E., Rosado, A., Martins, R. (2021). How has science highlighted sports tourism in recent investigation on sports' environmental sustainability? A systematic review. *Journal of Sport Tourism*, *25*(1), 42–65. https://doi.org/10.1080/14775085.2021.1883461.

Mattes, J. (2016). Attentional focus in motor learning, the Feldenkrais method, and mindful movement. *Perceptual and motor skills*, *123*(1), 258–276. https://doi.org/10.1177/0031512516661275.

Milner, E. K., Hancock, P. (1980). *The effects of an interdisciplinary collegiate program for secondary school students on their attitudes toward selected physical education and social concepts*

Mischenko, N., Kolokoltsev, M., Romanova, E., Bayankin, O., Kispayev, T., Vrachinskaya, T., Loginov, D., Aganov, S., Guryanov, M. (2023). Mixt-technology for the development of environmental competence in physical education classes in 7–9-years-old children. *Journal of Physical Education and Sport*, *23*(1), 52–58. https://doi.org/10.7752/jpes.2023.01006.

Newman, T. J., Alvarez, M. A. G., Kim, M. (2017). An experiential approach to sport for youth development. *Journal of Experiential Education*, *40*(3), 308–322. https://doi.org/10.1177/1053825917696833.

Nigg, C., Nigg, C. R. (2021). It's more than climate change and active transport—physical activity's role in sustainable behavior. *Translational Behavioral Medicine*, *11*(4), 945–953. https://doi.org/10.1093/tbm/ibaa129.

Orr, M., McCullough, B. P., Pelcher, J. (2020). Leveraging sport as a venue and vehicle for transformative sustainability learning. *International Journal of Sustainability in Higher Education*, *21*(6), 1071–1086. https://doi.org/10.1108/IJSHE-02-2020-0074.

Osborne, R. (2012). Physical education in the decade of education for sustainable development: a study with Brazilian physical education teachers and educators. *Human Movement*, *13*(3), 280–287. https://doi.org/10.2478/v10038-012-0033-2.

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., et al. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *PLOS Medicine*, *18*(3), 1–15. https://doi.org/10.1371/journal.pmed.1003583.

Paul, J., Criado, A. R. (2020). The art of writing literature review: what do we know and what do we need to know? *International Business Review*, *29*(4), 101717. https://doi.org/10.1016/j.ibusrev.2020.101717.

Potter, S. (2007). Rock hopping, yoga and student empowerment: a case study of a sustainable school. *Australian Journal of Environmental Education*, *23*, 13–21. https://doi.org/10.1017/S0814062600000677.

Raichlen, D. A., Pontzer, H., Zderic, T. W., Harris, J. A., Mabulla, A. Z. P., Hamilton, M. T., Wood, B. M. (2020). Sitting, squatting, and the evolutionary biology of human inactivity. *Proceedings of the National Academy of Sciences*, *117*(13), 7115–7121. https://doi.org/10.1073/pnas.1911868117.

Rieckmann, M. (2018). Learning to transform the world: key competencies in education for sustainable development. *Issues and trends in education for sustainable development*, *39*, 39–59.

Riley, K., Proctor, L. (2022). A physical education/environmental education nexus: transdisciplinary approaches to curriculum for a sense of belonging. *Australian Journal of Environmental Education*, *38*(3), 267–278. https://doi.org/10.1017/aee.2021.29.

Robert-McComb, J. J., Cisneros, A., Tacón, A., Panike, R., Norman, R., Qian, X.-P., McGlone, J. (2015). The effects of mindfulness-based movement on parameters of stress. *International Journal of Yoga Therapy*, *25*(1), 79–88. https://doi.org/10.17761/1531-2054-25.1.79.

Singleton, J. (2015). Head, heart and hands model of transformative learning: place as context for changing sustainability values. *Journal of Sustainability Education*, *9*(3), 171–187.

Sipos, Y., Battisti, B., Grimm, K. (2008). Achieving transformative sustainability learning: engaging head, hands and heart. *International Journal of Sustainability in Higher Education*, *9*(1), 68–86. https://doi.org/10.1108/14676370810842193.

Thapa, B. (2010). The mediation effect of outdoor recreation participation on environmental attitude-behavior correspondence. *The Journal of environmental education*, *41*(3), 133–150. https://doi.org/10.1080/00958960903439989.

Thapa, B., Graefe, A. R., Meyer, L. A. (2005). Moderator and mediator effects of scuba diving specialization on marine-based environmental knowledge-behavior contingency. *The Journal of Environmental Education*, *37*(1), 53–67. https://doi.org/10.3200/JOEE.37.1.53-68.

Triantafyllidis, S., Mallen, C. (2022). Sustainable development of sport. In S. Triantafyllidis C. Mallen (Eds.), *Sport and sustainable development* (1st edn., pp. 19–36). London: Routledge. https://doi.org/10.4324/9781003128953-2.

UNESCO (2015). International charter of physical education, physical activity and sport. https://unesdoc.unesco.org/ark:/48223/pf0000235409

UNESCO (2017). Education for sustainable development goals: learning objectives. https://unesdoc.unesco.org/ark:/48223/pf0000247444

UNESCO (n.d.). Education for sustainable development. https://www.unesco.org/en/education-sustainable-development

United Nations (1987). Report of the world commission on environment and development: our common future. https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf

UNOSDP (2014). Sport and the sustainable development goals—an overview outlining the contribution of sport to the SDGs. https://www.sport-for-development.com/imglib/downloads/unosdp2014-sport-and-the-sustainable-development-goals.pdf

Wals, A. E. (2012). Learning our way out of unsustainability: the role of environmental education. In *The oxford handbook of environmental and conservation psychology* (pp. 628–644). https://doi.org/10.1093/oxfordhb/9780199733026.013.0032.

Wals, A. E. J., Weakland, J., Corcoran, P. B. (2017). Preparing for the Ecocene: envisioning futures for environmental and sustainability education. *Japanese Journal of Environmental Education*, *26*(4), 71–76. https://doi.org/10.5647/jsoee.26.4_71.

Weed, M. (2005). "Meta interpretation": a method for the interpretive synthesis of qualitative research. *Forum: Qualitative Social Research*. https://doi.org/10.17169/FQS-6.1.508.

Zafeiroudi, A. (2020). Enhancing adolescents' environmental responsibility through outdoor recreation activities. *Academic Journal of Interdisciplinary Studies*, *9*(6), 43–55. https://doi.org/10.36941/ajis-2020-0110.